Railway Mechanical Engineer

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Railway Mechanical Engineer

Vol. 99 June, 1925 No. 6

Training in the art of leadership

The article or study on "Training foremen in leadership" in this issue, is based upon observations of the editorial staff of the *Railway Mechanical Engineer* and replies to a letter which was sent to the heads of the mechanical departments of the more important railroads in the United States and Canada. So much interest has been shown in this problem of helping the foremen and supervisors to perfect themselves in the art of leadership, that an attempt was made to round up the practices looking toward this end on all of the railroads. The study cannot be said to be complete, for it is apparent that not all of the officers who replied to our letter fully covered all of the things that they are doing to inspire and help the foremen to develop their leadership ability. It is surprising, however, to note the many different things that are being done. Other important developments are being tried out on some roads which are still in a more or less experimental state and which we are not permitted to divulge at this time. The big thing is that the railroad managements are awakening to the importance of this question and that the foremen themselves appreciate the situation and are keen to take advantage of anything that will help them to get better results.

The *Railway Mechanical Engineer* is always glad to hear from its readers, but we would particularly appreciate any suggestions from you concerning constructive steps which are being taken on this problem, which are not mentioned in the article or are not fully covered by it. We should like to know also, for instance, what particular thing has been most helpful to you in securing a better understanding of how best to direct and lead the men in your charge. Have you found some book or method or principle or agency particularly helpful? If so, tell us about it.

How much is a machine tool worth?

As the reader turns over the pages of the section devoted to new machine tools and devices he will find many machines and tools that will increase shop output. The question is, however, how do we determine their real worth? We can arrive at a certain figure by considering the quantity and quality of metal in the machine or we can estimate the cost to the manufacturer to build it. This method will, in principle, be somewhat akin to a story which was told recently by the master mechanic of a large shop on one railroad in the East.

Once upon a time, as all good fairy tales begin, there was an employer who paid his men according to their weight; in other words, the heavier a man weighed the higher the wage. Evidently the work was of such a nature that size and brute strength were the chief assets. As the business expanded the employer hired another assistant. The salaries of the two men were fixed according to their weights. It so happened that the small man was quite keen in working out clever schemes and kinks for improving production, while the larger man relied solely upon brute strength. The employer was forced to change the basis of wage payment.

There are many machine tool users who are inclined to estimate the worth of a machine from the standpoint of so much iron and steel or by what it cost the manufacturer to build it. But a mass of iron and steel cannot be made into a machine without first being organized in the mind of the designer.

The equipment produced today by the machine tool builders is the result of a process of evolution through an endless variety of mechanical apparatus designed to meet the needs of the time. It is the product of many years of experience, research and experiment. Brains has been the most important factor in the development of the modern machine tool, and it is constantly becoming better and more efficient. From the standpoint of the user the worth of a machine depends upon how much better and cheaper it can produce its product than other machine tools used for the same class of work.

The foreman's job

It has been said that the greatest undeveloped asset on a railroad is the human element. Two factors are necessary to release this great possibility—a broad and wise policy on the part of the management in dealing with its employees, and a capable, well-trained body of foremen and supervisors who can interpret the management to the men and lead them in a wise and tactful way, so that they may be developed to the limit of their capabilities. Morale is all-important in any organization. Experts who have been planning in recent years to bring the morale in the army to the highest possible standard have adopted as a slogan, "The army builds men." The meaning or intent of this is that each man is critically analyzed and studied, and is assigned to that class of work for which he is best suited and so directed that he will make the best possible use of the disposition and talents with which he is endowed. It is just as important to do this in an industrial or railroad organization as it is to do it in the army. No two men are alike. They differ widely in their likes and dislikes and in their individual characteristics. They will be happier and will give better service if they are used on that work for which they are best fitted by nature and if they are encouraged and trained so that the best use may be made of their peculiar characteristics.

This is no small task. It means that the foreman must be a keen student of human nature and must study how to deal tactfully and wisely with the most complicated and

sensitive of mechanisms—the human being. Some foremen and supervisors are succeeding in doing this in a big way. The author of the first prize article in the *Railway Mechanical Engineer* contest on the "Opportunities and possibilities of the Foreman," which appears elsewhere in this issue, is an outstanding example. We regret that we cannot use his real name, but his article more or less clearly reflects his personality and methods. It is worthy of the most careful thought and study, particularly if it is read in conjunction with the article on "Training foremen in leadership," which also appears in this number.

Incidentally, the prize article offers much in the way of suggestion for discussion topics at foremen's meetings and staff meetings. Do you agree with "Bill Brown?" Have you gone him one better in some respects? Can his suggestions be applied to your conditions? Has he overlooked or understated important principles? The *Railway Mechanical Engineer* will also be glad to have your reactions.

Terminal maintenance of passenger cars

The terminal maintenance of passenger equipment is one of the big problems of the car department, particularly at those terminals which handle a large volume of suburban traffic. A survey of the methods of handling a large number of units of equipment at terminals indicates that proper facilities and organization are woefully lacking. The location of the storage tracks, adequate facilities for making repairs, the right kind of organization for handling repairs, and the proper analysis of the terminal operating conditions are factors that must be given careful consideration in order to handle passenger equipment economically and with dispatch.

At the modern locomotive terminal the trackage is so arranged so as to reduce to a minimum the amount and the distance of the movements to get locomotives in and out of the terminal. Such is not generally the case with passenger cars at terminals. The storage tracks are usually a considerable distance from the terminal, which results in high shifting costs owing to the time and distance required to move equipment. This cannot be remedied over night but should be kept in mind when planning future terminal layouts. The operating conditions at a locomotive terminal are carefully analyzed so that the locomotives are quickly serviced and ready for their runs without any unnecessary delays. The operations at a passenger terminal afford the mechanical officers an unusual opportunity to make a graphic analysis of the arrival and departure of equipment so that each unit can be properly maintained without withdrawing it from service. In other words, the cars should be withdrawn from service after the morning peak traffic load, repaired during the day and put back in service to handle the evening rush hour traffic. The practice will reduce to a minimum the number of cars required to handle the traffic and will increase the car miles between shoppings.

In order to repair the cars between the morning and evening rush hours, the proper repair facilities must be provided convenient to the terminal. Proper facilities should also be provided for cleaning the cars and repairing trucks and wheels. A modern drop pit should be placed as convenient as possible to a wheel lathe. The usual practice is to have a large number of extra wheels on hand ready to replace worn ones; the removed wheels are then loaded on cars and sent to the nearest wheel lathe for repairs. This practice is expensive—a considerable amount of capital is tied up in extra wheels, to say nothing of the expense involved in transporting them to and from the repair shop. The location of a drop pit and a wheel lathe at the terminal will eliminate this expensive operation.

In the final analysis, the principal object of the plan of terminal operation outlined above is to increase the length of time between the shopping of cars, and in doing so, keep the number of cars going to the repair shops to a minimum.

The importance of knowing detail costs

Under the present system of accounting usually from 30 to 40 days elapse after the close of each month before the master mechanic knows the cost on his division per locomotive mile for repairs, lubrication, enginehouse expense, fuel, etc.—that is, if he waits for the various reports to be forwarded to him from the accounting department. From the standpoint of efficient shop management such figures are of comparatively little value for about the only way a master mechanic can ascertain whether his shop costs are increasing or decreasing is by personal investigation and inspection. Unless he has the results of a similar investigation to refer to, made at the time of the last report, an investigation made 30 or 40 days after the time to which the figures refer will avail little. The only way by which the master mechanic can have his cost figures when he needs and can use them is by getting them himself.

Cost finding is a complex matter at best and as railroad shops grow to greater proportions, this complexity will increase in like ratio. The methods and approximations which may be adequate for a small shop, cannot be relied upon when the plant becomes so large that personal observation by the master mechanic or shop superintendent is insufficient. In many railroad shops, where so-called cost systems have been installed, the cost system is considered satisfactory if it simply shows the cost of performing a certain class of repairs. But the modern conception of a cost finding system is much more exacting. Such a system should show costs in such a form that deductions may be drawn as to the reasons for them and the possibilities of reducing them.

A system of this kind would undoubtedly require a considerable increase in the office force of the master mechanic, but a cost-keeping system that simply records costs for the purpose of knowing the expenditures made, say for a given class of repairs, has accomplished only a small part of its mission. Efficient shop management requires a knowledge of the activity of each department so that the master mechanic or shop superintendent can take proper steps when necessary to apply remedial measures.

It is not only true of the railroads, but of other industries as well, that the art of cost finding is still in a crude and undeveloped stage, so far at least as individual detail costs are concerned. That there is a growing appreciation of the importance of cost finding among mechanical department officers is evidenced by the extensive installation of shop scheduling systems in which repair costs are taken into account and the recent studies made by various roads as to the utilization of money appropriated for repair work. A recent example of where the money expended for repair work has been made the fundamental factor of the shop administration is at the Finley shops of the Southern Railway, Birmingham, Ala. A description of the locomotive unit was published in the March issue of the *Railway Mechanical Engineer* and the car shops are described elsewhere in this issue. Both shops are under the same administration and real progress has been made during the short period they have been in operation, by proper control of labor and material expenditures.

The system at the Finley shops, however, as well as in

the majority of other shops throughout this country where cost systems are in operation, does not deal with the finding of the detail costs. The knowledge of what it costs per locomotive mile for repairs, enginehouse expense, etc., will possibly arouse the master mechanic to action if his costs are too high in comparison with those of other divisions. But figures showing only general or summarized costs are of little practical benefit to the master mechanic or shop superintendent if he wants to know where the money is being spent to the least advantage. He must have available more detail data.

Planning for the future

Complaint is frequently voiced against the treatment received by mechanical department budgets at the hands of the executives responsible for capital expenditures. To some extent the lack of sympathy with the plans of the mechanical department for improving its facilities is the result of the position of the mechanical department in the railroad organization because it is primarily a spending and not an earning department. Locomotives and cars are the tools of the railroad by which it produces the ton-miles and passenger-miles from which the revenue of the road is derived. The value of these facilities and of improvements in them which will increase the ratio of revenue-producing capacity to the cost of their operation is much less difficult of appreciation by the executive than is the value of machine tools, ash and inspection pit facilities or modern drop pit, boiler washing and material-handling facilities which in the mind of the executive are not primarily connected with the production of transportation. The details of their operation are incomprehensible to the average executive and he is not interested in them.

It is a question, however, whether the executive is entirely responsible for the viewpoint with which he approaches the consideration of requests for appropriations to provide these facilities or to replace those which have outlived their usefulness with modern units capable of reducing maintenance costs and increasing equipment capacity by keeping it in service for a larger percentage of the time. Is not the mechanical officer himself in a measure responsible for this situation?

Many mechanical department budgets present to the executive a long list of details, each machine tool or other facility representing in effect a separate project with its own explanation and justification which goes into details of shop operation in which the executive is not interested and to which he cannot give the necessary attention to arrive at a thorough comprehension of the possibilities or of how each detail dovetails into the complete equipment maintenance structure. The entire budget is thus open to attack piecemeal. On the other hand, a grade revision program is presented as a whole and a bridge here or a signal there are details which must be accepted if the project as a whole is accepted.

Is not the mechanical department suffering in a measure from a lack of a comprehensive survey of its needs and possibilities? Is there not an opportunity for a complete survey of the situation as a whole on each road and the formulation of a program of improvements which not only meets the immediate requirements but looks ahead to the ultimate development of completely co-ordinated facilities to form a plant from which the maximum equipment serviceability may be obtained from a minimum expenditure per equipment unit? Such a program, it is true, will call for the expenditure of millions of capital instead of thousands, but it will present a comprehensive and comprehensible picture to the executive. The results can be measured in more serviceable locomotive-hours and in decreased cost of locomotive and car maintenance per unit of service, which means far more to the executive than, for instance, a saving of a few minutes or even a few hours in machining a crank pin or valve chamber bushing by the installation of a new turret lathe or a new boring mill.

The results of a complete program of rehabilitation, carefully worked out to facilitate the extension of locomotive runs, for instance, which the operating department may have in mind, have a direct appeal to the executive which will at least lead to sympathetic consideration and meet with less opposition than would an unco-ordinated list of tools and other facilities. A project requiring the expenditure of ten million dollars, carefully spread over a period of say ten years, resulting in improved equipment utilization and decreased costs which could be measured in terms of their effect on the operating ratio would probably be less difficult to put over than a one hundred thousand dollar project for ten or fifteen new machine tools, each of which would amply justify itself, but the results of all of which together could hardly be found in the operating ratio. The mechanical officer of vision and enterprise has a big opportunity at least to put himself and his department in a position to command the attention and respect of his executive, and in some cases even of his board of directors.

What Our Readers Think

Supply salesmen should read this letter

[The writer of the following letter asked that his identity be concealed]

To the Editor:

There is, I believe, no one in charge of a railroad shop more interested in the supply salesmen and their wares than the writer, who thinks he has learned more of the progress of inventions and what improvements are being made in the interest of shop production from these men than perhaps from any other source, except it be from the advertising and other pages of the mechanical journals.

In view of this belief, his office door is always open to them and he is never too busy to discuss with them the goods they wish to call attention to. As a class, they are above the ordinary man in specialized knowledge and whoever thinks he knows more than these men, has probably overlooked something that would be to his own advantage and material interests. All of which is merely mentioned to show his attitude towards mechanical salesmen as a class. However, the following interview took place recently in his office and is submitted in the hope that it will reach the attention of the class of men he is so partial to and that it will be of benefit to them:

"Good morning, Sir. Are you Mr. B——, superintendent of these shops?"

"Yes sir."

"Well I am representing the ——— Tap Company. We make the finest line of taps made. Our stay bolt taps are a specialty with us. They have become standardized on the X.Y.Z. railroad, after severe competitive tests. I have also conducted tests on the A. B. C. and on the P. D. Q. railways with excellent success and have proved our taps to be better than our competitors'."

"Well, that is quite interesting. How do you mean they proved themselves to be better? Were yours high speed steel and the other fellows' carbon?"

"No sir. They were all carbon steel taps but we tapped more holes than the other fellows."

"How many holes did you tap before they failed?"

"Well, I did not keep tab on the number of holes tapped but ours did the most holes."

"Don't you think it it would have been valuable data to have the number of holes each tapped?"

"Well, it might be."

"What was the thickness of the boiler plate you were tapping?"

"Oh! The usual kind of fire box plate. I did not measure the thickness. But it was the same thickness for all the taps tested."

"What revolutions per minute were the taps used at?"

"Why, as fast as the motors would run."

"You do not know the r. p. m. then, at all?"

"No, I did not think that was necessary."

"What make of air motors did you use? Perhaps we can find out the r. p. m. from that information if you have the air pressure used."

"I do not know the air pressure but one motor was a Little Giant, I think they call it. I do not know the make of the others."

"Well, were they all the same make?"

"I am not sure of that."

"What lubricant did you use on the test?"

"Well, I do know that, it was a heavy oil."

"What kind of oil?"

"A very heavy dark colored oil they put on with a paint brush."

"But you have no idea just what oil it was?"

"No sir. I did not think that made any difference."

"In your traveling around with these stay bolt taps, what lubricant do you find the most used when tapping stay bolt holes?"

"I never took any particular notice of them."

"You say your taps beat the other makes in number of holes tapped. Just what do you attribute it to, that they proved able to tap the greatest number of holes before failing?"

"Well our factory uses the greatest care in selection of steel and they have a special method of tempering them."

"Are the threads of your taps ground or cut in the lathe?"

"I don't know just how they are threaded. But I do know they grind them after they are threaded."

"What make of taps were those you tested yours against?"

"Well, we salesmen do not make a practice of naming our competitors' goods when talking to prospective customers."

"But you did get the names of them, did you?"

"Oh, yes!"

"Well let me tell you a few things without intentionally hurting your feelings at all. I must say you have yet much to learn before you become a successful salesman. You were, according to the ethics of your business correct, I suppose, in not mentioning the names of your competitors' goods to me. At least, I believe that is what the sales managers teach, although I do not know exactly why. That much you appear to have learned thoroughly. But how much more welcome you would be in here were you able to give me more particulars of your test. To tell me that the speed was, say, 250 r. p. m., through Luken's or Otis' or some other brand of ⅜-in. fire box steel. That paraffine oil was first used but that the taps all appeared to get rather hot and that white lead was tried with good results. That the best one tapped 2,180 holes and the next one 2,000 and the other one 1,860. That the reason you believe your tap to be the best was because your company was continually making tests in the factory. That one tap out of each batch, picked at random had to go through so many holes at such a speed before the others were sent out. That you had spent considerable time in the factory watching the process of manufacture and the expert care exercised to get them the correct size and temper. To explain the Brinell testing of them, stating that while ground taps may last somewhat longer and would cut a more accurate sized hole and are an excellent tap where interchangability is necessary, still for boiler work, the taps threaded in the lathes are quite practicable enough and cost much less.

"That there appears to be a great variance of opinion as to which is the best lubricant to use but from your own personal observation, leaving out the cost of it, a mixture of white lead and linseed oil in certain proportions gave the greatest number of well threaded holes per tap. That the r. p. m. varies all the way from 100 to 275 in different localities. That in some places where they practice electric welding for closing up the old holes of the fireboxes no make of tap will successfully stand up, where owing to high voltage or other causes, the hole has been made almost as hard as the tap itself. Now I am sure you will take this advice from an old salesman in the spirit it is given. Take this pass out to the boiler shop and ask the foreman for all the information on taps and tapping he can give you. I will call him on the phone and tell him to look out for you. Good-bye and good luck to you. Well, thanks, I'll take one, I don't smoke myself but will give it to my chief clerk. Call again some day."

SHOP SUPERINTENDENT

Wear of cross-compound compressor cylinders

MILWAUKEE, Wis.

TO THE EDITOR:

In the April, 1925, *Railway Mechanical Engineer*, page 200, there was an inquiry from R. J. K. for an explanation as to why the air cylinders of the 8½-in. cross-compound air compressor do not have the greatest wear at the same points on the cylinder walls as the 9½-in. and 11-in. compressors.

While it is possibly true that under certain conditions the wear of the high-pressure air cylinder of the cross-compound compressor will be different from that of the 9½-in. or 11-in. compressors, the low pressure air cylinder will be found to wear exactly the same as those of the other compressors; that is, the least wear of the cylinder wall will be found at the center of the piston stroke.

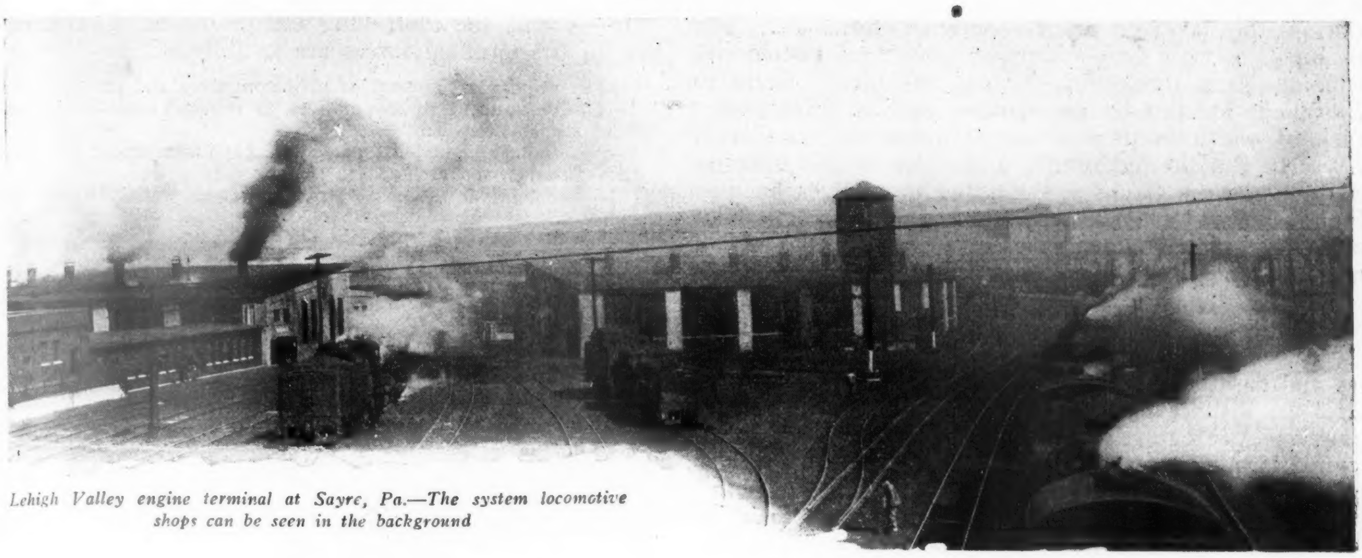
The excessive wear near the ends of the cylinder is caused by the packing rings being pressed harder against the cylinder wall as the compression of the air increases toward the end of the piston stroke. The cylinder walls of all air compressors should wear more at the ends than in the center on account of the increased friction of the rings. The cylinder wall of the high-pressure cylinder of the cross-compound compressor will also wear in this manner if the compressor is properly balanced, but it should be borne in mind that it cannot be properly balanced for all main reservoir pressures. For illustration, if properly balanced when operating with 200 lb. of steam against 100 lb. main reservoir pressure, it would be out of balance when operating against 130 lb. main reservoir pressure for the reason that the high-pressure steam piston, with 200 lb. steam pressure, can only compress the air in the low-presure air cylinder to approximately 40 lb., all further increase of pressure being accomplished by the low-pressure steam, high-pressure air piston. When the cross-compound compressor is operating against low main reservoir pressure, the low-pressure steam, high-pressure air piston will complete its stroke to the end of the cylinder, but when the main reservoir pressure is high, this piston stops a greater or lesser distance from the end of its stroke.

The low-pressure piston is a floating piston and is in no way connected to the valve mechanism. When this compressor is in a service which requires high main reservoir pressure, such as passenger service where 110 lb. brake pipe and 130 lb. main reservoir pressures are standard, there will be very little wear of the cylinder wall at the end close to the counterbore. The greatest wear, however, will not be in the center as stated by R. J. K., but a certain distance back of the counterbore. In other words, this cylinder will wear in the same manner as those of the other compressors within the zone of its piston stroke. When calipering this cylinder it will be found that the smallest diameter is near the counterbore, the next larger diameter at the center and the largest diameter a short distance from the counterbore.

The low-pressure steam, high-pressure air piston stops before completing its full stroke because of the by-pass grooves which are placed in both ends of the low-pressure steam cylinder. There are three by-pass grooves machined in each end of the low-pressure steam cylinder wall, each groove is 2 in. long, ⅝ in. wide and 3/16 in. deep. When the piston, operating against high main reservoir pressure, uncovers these grooves, the steam escapes and the piston stops, with the result as before stated.

JAMES ELDER,

General air brake supervisor, Chicago, Milwaukee & St. Paul.



Lehigh Valley engine terminal at Sayre, Pa.—The system locomotive shops can be seen in the background

Assignment of locomotives for enginehouse repairs

Re-organized forces and co-operation increase efficiency of Lehigh Valley engine terminals

ENGINE terminal running repair practice has always been considered an entirely different problem from locomotive shop work, owing to the necessity of taking into consideration the unexpected element of emergency situations. A terminal which can anticipate the unexpected and be in a position to provide power for emergency requirements at times of peak traffic without disrupting the despatching schedule is indeed unusual. And yet, this apparently can be attained by departing, in some respects from usual engine terminal practice and intelligently applying a successful feature of modern back shop practice; namely, specialized gangs and assigned work. While the following article deals entirely with the application of this principle at the Sayre, Pa., engine terminal, the same operations are standard at all other terminal enginehouses on the Lehigh Valley.

Inbound inspection pit—Note the nickel plated head casings on the passenger locomotive

The Sayre engine terminal is one of the most important on the Lehigh Valley. The operations at this terminal present a most interesting example of the value of thoroughly analyzing operating conditions and then inaugurating practices to improve them which constitute a radical departure from established precedent. This terminal is located at approximately the mid-point between Buffalo, N. Y., and New York City and despatches power for slow and fast freight, passenger, milk and yard service. During the twelve months period ending March 31, 1925, this terminal despatched an average of 3,580 locomotives per month for all classes of service, an average of 118 for each 24-hr. day. The maximum number of locomotives despatched during any one month in that period was 4,013 during October, 1924, an average of 130 per day.

Slow freight power is despatched for runs to Manchester, N. Y., on the west and Coxton, Pa., on the east. Power for milk and fast freight service is despatched from Sayre to Lehighton eastbound, a distance of 152 miles; for main line passenger and fast freight service from Sayre to Buffalo, N. Y., westbound, a distance of 176 miles, and for passenger service from Sayre to Easton eastbound, a distance of 194 miles. Sayre is the home repair terminal for most of the power despatched. Most of the locomotives are used on turn-around runs, only inspection and light running repairs being made

during the lay-over at the outlying terminals. For example, in main line passenger service one locomotive running on a through passenger train from Sayre to Buffalo is handled on consecutive days by three crews, each of which in turn makes a turn-around run from Sayre to Buffalo and return, a distance of 352 miles in 24 hr.; between Sayre and Easton, locomotives handled in the same way make 388 miles in 24 hr. Passenger locomotives on these runs will average from 10,000 to 12,000 miles per month.

For some time past the Lehigh Valley, particularly on the Seneca division, has made a practice of complete assignment of power to road crews in all classes of service and has found that this method of handling locomotives has distinct advantages over the practice of pooling power. All regularly assigned engine crews have assigned locomotives and an extra board is maintained to cover jobs created by regular men laying off, and extra trains, such as special or work trains. If an extra job is boarded for five or more consecutive days, it becomes a regularly assigned job with an assigned locomotive.

The Sayre engine terminal consists of a 40-stall brick enginehouse and an annex shop with 10 repair tracks served by a transfer table. Owing to the fact that the annex shop is of comparatively old construction, it has not been possible to provide overhead crane facilities without the necessity of making expensive building alterations. Therefore, in order to handle the heavy modern power adequately a 200-ton Whiting locomotive hoist was installed. The annex machine shop is equipped with machine tools as follows:

2 Vertical boring mills.	1 Slotter.
1 Horizontal boring mill.	2 Shapers.
3 Drill presses.	1 Hydraulic press.
1 Turret lathe.	3 Emery grinders.
2 Planers.	1 Steam hammer.
1 Wheel lathe.	1 Power hack saw.
11 Engine lathes.	

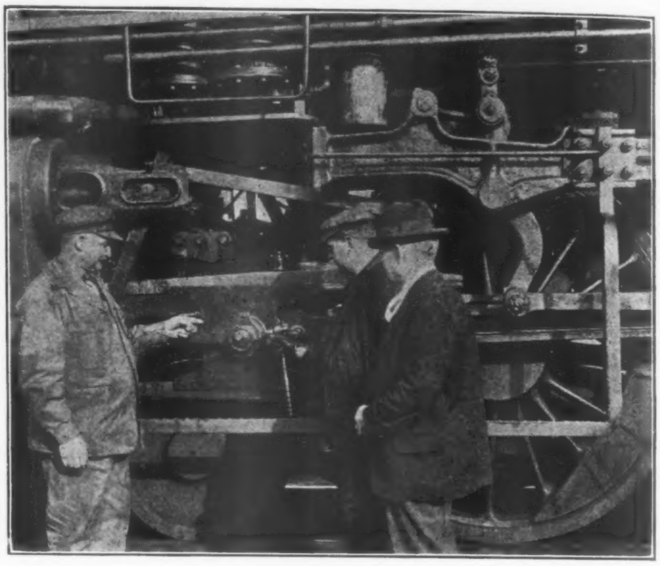
Re-organized plan of operation

The realization of certain advantages gained from assigned power raised the question in the minds of mechanical department officers as to why these advantages might not apply in a different way to the methods of handling repair work at the engine terminal. As a consequence, after a careful study of conditions, a complete re-organization of forces was made at the Sayre engine terminal in the early part of 1924 and a new system of handling running repairs, which is described in this article, was put into effect about April 1, 1924.

Flood lighting in the enginehouse facilitates night work

In general, the controlling factors of the re-organization of the terminal forces are as follows:

1—The regular assignment of all locomotives and engine crews.
2—The assignment of locomotives to regular enginehouse mechanics for maintenance.
3—A definite assigned list of serviceable locomotives:
(a)—Locomotives assigned to regular crews.
(b)—Locomotives assigned extra to replace regular locomotives withdrawn for repairs or to handle emergency business. Under this classification there are eight serviceable locomotives assigned at all times, four for the eastbound board and four for the westbound board.

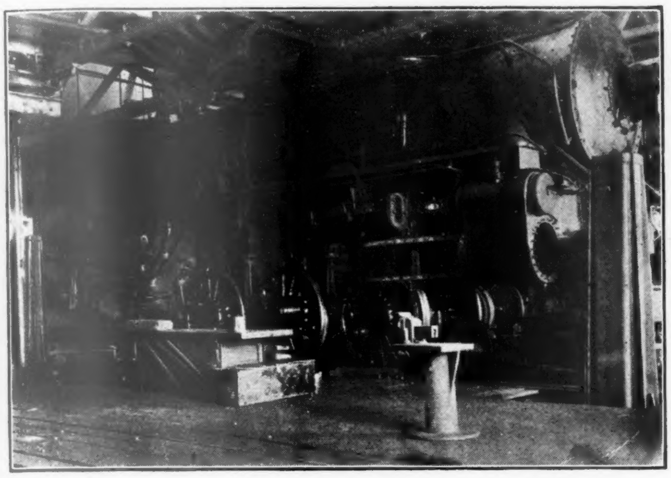


Co-operation between road and shop men has raised the maintenance standard

4—Enginehouse forces handle and despatch only serviceable power.
5—Enginehouse forces handle no heavy work and there is no despatching of locomotives on anticipated repairs.
6—The complete separation of enginehouse forces into two groups:
(a)—Forces to handle despatched serviceable power.
(b)—Forces to handle heavy repairs and to maintain and provide serviceable locomotives for regular assignment.
7—Division of stalls in the enginehouse with specified pits and repair forces for certain classes of power:
(a)—Stalls Nos. 1 to 20, inclusive, for freight repair forces handling serviceable heavy power.
(b)—Stalls Nos. 21 to 32, inclusive, for heavy repair forces, handling all washouts and locomotives withdrawn from service for general maintenance. In order to facilitate the handling of heavy repair work, pits Nos. 21 to 32 were selected because of their close proximity to the annex machine shop and enginehouse storeroom.
(c)—Stalls Nos. 33 to 46, inclusive, are assigned to passenger and light power forces, handling passenger, light freight and yard locomotives.
8—The inauguration of regular meetings of the engine terminal supervisory forces on the following schedules:
(a)—Daily meetings held at 8:00 a. m. to discuss the handling of schedule work, despatching of power, emergencies, detentions and discipline.
(b)—Weekly meetings to discuss the scheduled withdrawal of locomotives for the following week, defining the work to be done, this work being determined by special inspection; the scheduling of washouts, and general discussions.
(c)—Monthly meeting for the discussion of work scheduled for the following month, at which time all heavy work is determined for the enginehouse heavy repair forces, including locomotives to be shopped in the annex and locomotives to be sent to the system shop, which is located at Sayre. The division road foremen of engines attend these regular monthly meetings in order to discuss with the master mechanic and engine terminal supervisors the work which should be done on locomotives as discovered by them on the road.

In many modern engine terminals the tendency has been in recent years to have specialized gangs look after

certain well-defined classes of repair work. This is in line with the common practice of classifying and specializing repair work in locomotive shops. The important difference in the organization methods described here lies in the fact that there are not only specialized gangs in the engine terminals, but that to each gang is assigned



Wheeling a heavy Pacific type locomotive on the 200-ton hoist in the annex

a definite number of individual locomotives for the maintenance of which they are solely responsible.

Enginehouse organization

The general enginehouse foreman who reports directly to the master mechanic has under him two general foremen, one responsible for all repair work in the enginehouse, and the other in charge of the annex shop. In addition to these two general foremen, the boilermaker foreman and the labor foreman report directly to the general enginehouse foreman.

Reporting directly to the general foreman in charge of the enginehouse proper are four gang foremen in charge of the following work:

1—All heavy repair work on locomotives out of service, which are being handled in stalls Nos. 21 to 32.

2—All running repair work on serviceable passenger power, which are being handled in stalls Nos. 33 to 46.

3—All running repair work on serviceable freight power, in stalls Nos. 1 to 20.

4—Specialty foreman in charge of gangs assigned to air brake work, booster maintenance, stoker maintenance, flange oilers and drifting valves, lubricators and superheater damper cylinders, all pipe work on live and dead power, repairs to air reverse gears on live and dead power, all cab valve work, setting safety valves and boiler inspection certificates, and electric headlight maintenance.

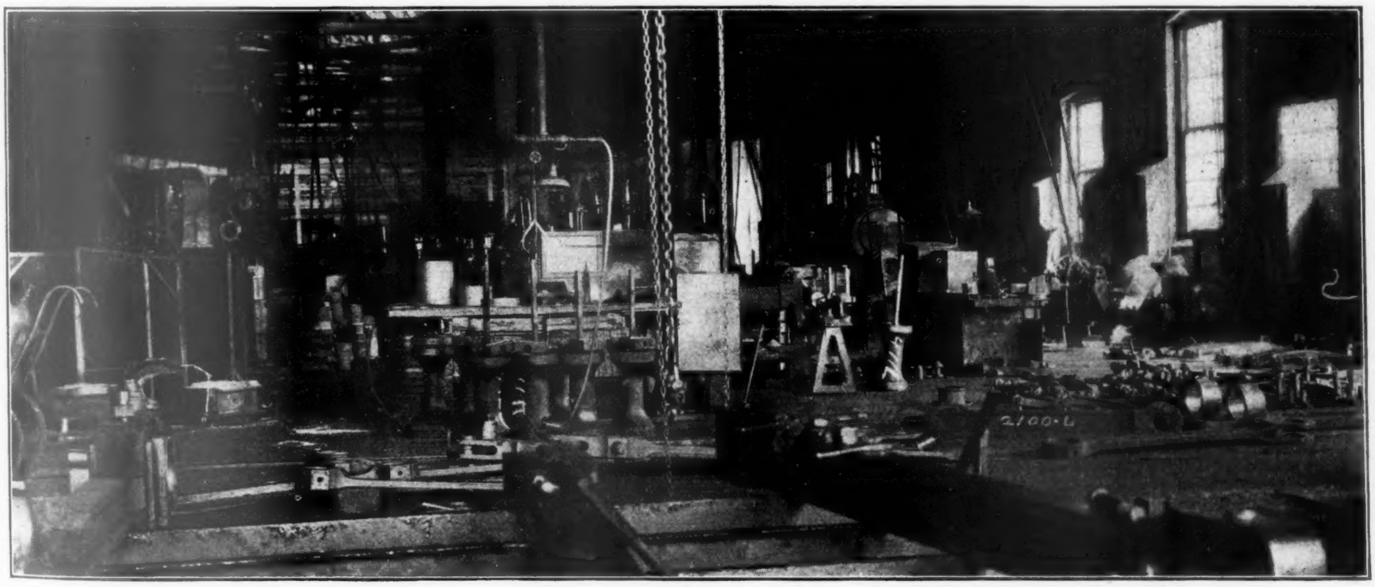
Every effort is made to increase the time locomotives are available for service and this system has made it possible to effect an appreciable reduction in the time required to repair a locomotive. Likewise, a very close check is kept on the matter of terminal delays.

Terminal inspection and maintenance records

When a locomotive comes into the terminal after a run it passes over an inspection pit on the inbound track. This pit is 160 ft. long and is provided with electric lights to facilitate the inspection of inaccessible parts of the running gear at night. The inbound inspector makes a report on the same blank form as that used by the engineman, and copies of this report are furnished, together with the engineman's report, directly to the gang to which that particular locomotive is assigned. While all foremen receive copies of work reports for locomotives which are maintained by the gangs under their supervision the fact that each gang knows exactly what work is expected of it on certain assigned locomotives relieves the foreman of the necessity of assigning work slips.

As previously mentioned, the gangs handling the running repairs on live serviceable power in the enginehouse work only on serviceable power, for as soon as a locomotive is scheduled for repairs sufficiently heavy to require its withdrawal from service, it is immediately transferred to the heavy work section of the house or to the annex shop. In this way repair work is concentrated, there being no dead engines in the two sections of the house assigned to serviceable power. All washouts are handled in the heavy work section, and the washouts are so scheduled that they are made on week-days only, any locomotives on which the washout date falls on Sunday are scheduled to be washed before that day.

The value of complete maintenance and running repair records is appreciated and regular reports are distributed among the supervisory forces such as those covering the daily, weekly and monthly meetings. One report par-



View at one end of annex shop

ticularly which seems to be worthy of special mention is a set of two records which are kept on driving box grease consumption. One of these is a daily record showing that an inspection has been made of each driving box on each locomotive, and if it has been necessary to apply grease, a record of the amount of grease is entered in the column of the report showing the particular driving box to which the amount of grease was applied. This daily report is filled out for all locomotives despatched during the 24-hr. period. The second form provides a monthly record of grease consumption for each individual locomotive, the information for which is transferred from the daily report. Both reports show the mileage made by the locomotive. These records have enabled the master mechanic to keep in very close touch with the hot journal situation, as it can readily be seen that if the report indicates that any particular driving box on a certain locomotive is requiring more than a normal amount of grease, it is an indication that attention is required. In this way it is practically always possible to anticipate "hot journal" trouble and remove the cause before it becomes serious.

Scheduling heavy repairs

A scheduling system for the annex repair shop has been installed which is remarkably simple in operation and requires very little work on the part of the supervisory forces to keep it posted. The forms used in connection with this schedule system are shown in Figs. 1 and 2. When a locomotive is placed in the annex shop for repairs, the work to be done on it is determined by a special inspection and a special work report is furnished to the general foreman in charge of the annex. The form shown in Fig. 1 shows the various items of work to be performed by the different departments on each consecutive day while the locomotive is in the shop. The general foreman of the annex shop indicates on this form each morning whether or not all work which is scheduled for that particular date has been done. For example, the form shown in Fig. 1 is filled out and it

Driving Box Grease Consumption -- Individual Engine Record
Sayre Enginehouse

Eng. No. 2092 Month of March 1925

Date	Box R-1	Box R-2	Box R-3	Box R-4	Box L-1	Box L-2	Box L-3	Box L-4	Total Mileage
1	OK	OK	1 lb.		OK	OK	OK		390
2									
3									
30									
31									

These records show the history of driving box conditions on each locomotive during the month

will be noted that locomotive No. 462 which was put in the shop on March 12, 1925, for Class 5 repairs, was scheduled out on March 29, 1925. By referring to the form shown in Fig. 2, it will be noticed that a cross has been marked under the twelfth day of the month which indicates that this engine entered the shop on that day. As previously stated, in the daily foremen's meeting, the schedule form shown in Fig. 1 is checked up each day, and providing all work which has been scheduled to be done on a certain locomotive has been completed on schedule time, a cross mark is entered on the progress form for that day. If any of the items on the schedule

Class 5 Repairs

Engine No. 462
Date in 3/12/25
Date out 3/29/25

Date Days	Engine-house	Boiler shop	Annex floor erecting	Smith shop	Machine shop	Rods and motion work	Stokers, pipe and special work	Carmen work	Tin shop
1	Placed in hse.	Inspected washed							
2		Flues removed							
3		Flues and bolts							
4		Test							
5			Wheels removed			Rods received			
6					Boxes received	Motion work received			
7			All parts delivered				Stoker parts delivered		Motion work
8			Hub size given						Cross-heads
9				Frame work	Motion work				
10				Spring rigging	Cross-heads	Valves and motion			
11			Valves and crossheads	Brake rigging					
12			Guides and pistons	Truck work					
13		Jacket lagging	Frame work		Wheels				
14			Shoes and wedges laid out					Cab	
15		All work	Spring work		Shoes and wedges	Rods	Pipe work	Sash	
16			Wheeled					Engine painted	
17	Engine coupled	Fired up							
18	Break in								
19									

Fig. 1—Form for indicating work to be performed by different departments on each day while locomotive is in the shop

form have not been completed on time the space for that particular date on the progress record is left blank.

It can be readily seen that if all work on all locomotives has been completed to date, there will be a cross in the daily column on the progress record for all locomotives remaining in the shop. By referring to Fig. 2, this can be seen under the column headed March 26. The first four lines of the progress record under the date of March 26 are blank because of the fact that these locomotives have previously left the shop on the dates indicated by the circles.

If for any reason the work on any particular locomotive is not up to schedule, the blank space opposite the number of that locomotive and under the current date on the progress report will constitute a break in the continuity of the vertical lines of crosses. Wherever a blank space appears on a progressive record for any day, it is a warning to the master mechanic that the work on that particular locomotive is behind schedule and he can immediately have an investigation to determine the cause.

The foremen's training classroom

Increased efficiency obtained

The inauguration of this plan of maintenance has resulted in increased efficiency in many ways. The feature of assigning locomotives to definite gangs has not only relieved the supervisors of a great amount of detail work, but it has served to definitely fix responsibility for all work. The average running repair gang working on serviceable freight and passenger power does not have more than seven to ten assigned locomotives to maintain, and, because of the fact that they are working on the same locomotives day after day, they are able to keep in close touch with the work required. Also, the road crews have come to know the men in the enginehouse who maintain the locomotives they handle and in this way a spirit of co-operation has been brought about which is being reflected in a higher standard of maintenance.

A concerted effort has been made to effect a reduction in terminal detentions. To this end a bulletin board was posted in the enginehouse on which every terminal detention is marked up, showing the engine number, the actual number of minutes delayed, the cause of delay and the *man responsible.* This practice has had its effect and, inasmuch as the terminal detention record may be considered a fair indicator of the over-all efficiency of the enginehouse organization, it is interesting to note the consistent reduction in terminal detentions, as shown by Table I, over a period of 15 months, and particularly since the present system went into effect in April, 1924.

Table I—Locomotives despatched and terminal detention at Sayre by months

	Locomotives despatched	Terminal detention hr.	Terminal detention min.	No. min. delay per 100 locos. despatched
January, 1924	3,740	15	45	25.2
February, 1924	3,509	11	50	20.2
March, 1924	3,611	29	38	49.4
April, 1924	3,387	25	35	47.0
May, 1924	3,696	10	15	17.1
June, 1924	3,322	13	0	23.5
July, 1924	3,337	6	45	12.2
August, 1924	3,537	9	35	16.3
September, 1924	3,644	6	30	10.7
October, 1924	4,013	9	47	14.7
November, 1924	3,737	8	33	19.1
December, 1924	3,471	6	5	10.5
January, 1925	3,283	6	50	12.5
February, 1925	3,246	8	38	15.9
March, 1925	3,308	3	50	6.9

Likewise, a marked improvement is evident in the matter of locomotive failures on the road. The average number of failures per month during the first six months of 1924 was 23 and the average number of locomotive-miles per failure was 18,788. During the last six months of 1924 the average number of failures per month had dropped to seven and the mileage per failure had increased to 56,181. In October, 1924, there were only six failures and the mileage was 69,624. These figures are averages for all classes of service. Incidentally, the reduction in the number of locomotive road failures has had a beneficial effect on the average car mileage per day.

Lehigh Valley Railroad
Schedule and Progress of Locos. Through Enginehouse and Shops
Sayre Annex -- Month of March
Seneca Division, Sayre, Pa.

Class Repairs	Engs. in shop	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
6	3253		X	X	X	X	X	X	X	X	X	X	X	O																		
5	2121				X	X	X	X	X	X	X	X	X	X	X	X	X	X	O													
5	448						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O								
5	2104								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O						
5	471										X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
5	462												X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
5	2100																	X	X	X	X	X	X	X	X	X	X					
5	446																			X	X	X	X	X	X	X	X					
5	452																								X	X	X					

Fig. 2—Form for recording the progress of locomotives through the shop

Employee relations

Practically no effort has been spared on the part of the Lehigh Valley to improve the morale of all the employees. At the Sayre terminal, which is located adjacent to the large system shops, many novel features have been inaugurated to promote cordial relations. An assembly hall has been provided in which social functions take place and in connection with the assembly hall a cafeteria has been established for the convenience of the men. A man has been assigned from the organization at Sayre terminal who devotes his entire time to personnel work among the enginehouse employees.

The enginehouse mechanics are all employed on a

day-work basis and a service record is kept for each man. With the system of assigned repairs in effect, it is a comparatively easy matter to know the individual is performing his duties, and these records are carefully checked up periodically with the idea of properly rewarding meritorious service or administering discipline, should the occasion demand.

Another feature of the personnel work is the recent establishment of a foremen's training class. The entire supervisory force of the enginehouse and annex, consisting of 25 men, has enrolled in the correspondence engineering extension department of the Pennsylvania State College and are pursuing studies bearing on the important factors of employee relations and the principles of shop organization. A special room has been set aside for the use of the foremen's training class and it is gradually being equipped with all facilities required in a classroom of this description, including many charts and drawings used for instruction purposes as well as a library of important technical books and periodicals. The foremen's training class meets at least once a week and all are carrying on their studies in the extension course at the same rate of progress, class instruction rather than individual study constituting the program.

Conclusion

A study of operating conditions at the Sayre terminal after the organization had been in effect for a period of about 12 months disclosed the fact that it had been possible to effect a reduction of terminal operating expenses and at the same time increase the output. The assignment of locomotives and crews has made it possible to increase the number of turn-around runs, and locomotives are assigned as nearly as possible to trains for which they are particularly suited. It has also been possible to effect a decrease in road supervision and engine crew expense due to improved operation and maintenance. As a means of direct comparison, considering the first two months of 1925 and the same two months of 1924, the records show a reduction of 30 per cent in man-hours, 63 per cent in overtime, 27 per cent in payroll and 40 per cent in materials used. A reduction in force of approximately 110 men has been made possible by the re-organization. It might be added that most of these men have been absorbed by transfer to other departments or other points on the road and have not been released from service. For the above-mentioned period there has been an average total reduction of approximately 30 per cent in all the terminal operating expenses chargeable to the locomotive department.

Daily Consumption of Driving Box Grease
Sayre Enginehouse

Eng. No.	Box R-1	Box R-2	Box R-3	Box R-4	Box L-1	Box L-2	Box L-3	Box L-4	Total Mileage	
2092	OK	OK	1 lb.	OK	OK	OK	OK	OK	390	

Sayre, Pa. (Signed) ____________ Box Packer

____________ Date

Daily record of driving box conditions and grease consumption

One of the outstanding facts in connection with this terminal operation is that conditions are such that it is possible to keep ahead of the work at all times. As previously mentioned, eight locomotives are maintained ready for emergency service so that it is not necessary to despatch power on anticipated repairs.

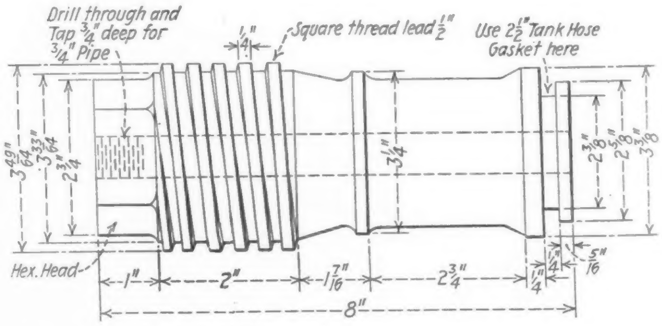
In considering the results of this operation, the fact must not be overlooked that the Lehigh Valley has made remarkable progress in establishing a spirit of co-operation among its employees. The new scheme of enginehouse organization did not meet with instant favor. After over a year of actual operation, however, it has demonstrated distinct advantages not only to the company but to the men, who are keenly enthusiastic over its possibilities.

Nozzle for testing feed-water heaters

By A. T. E.

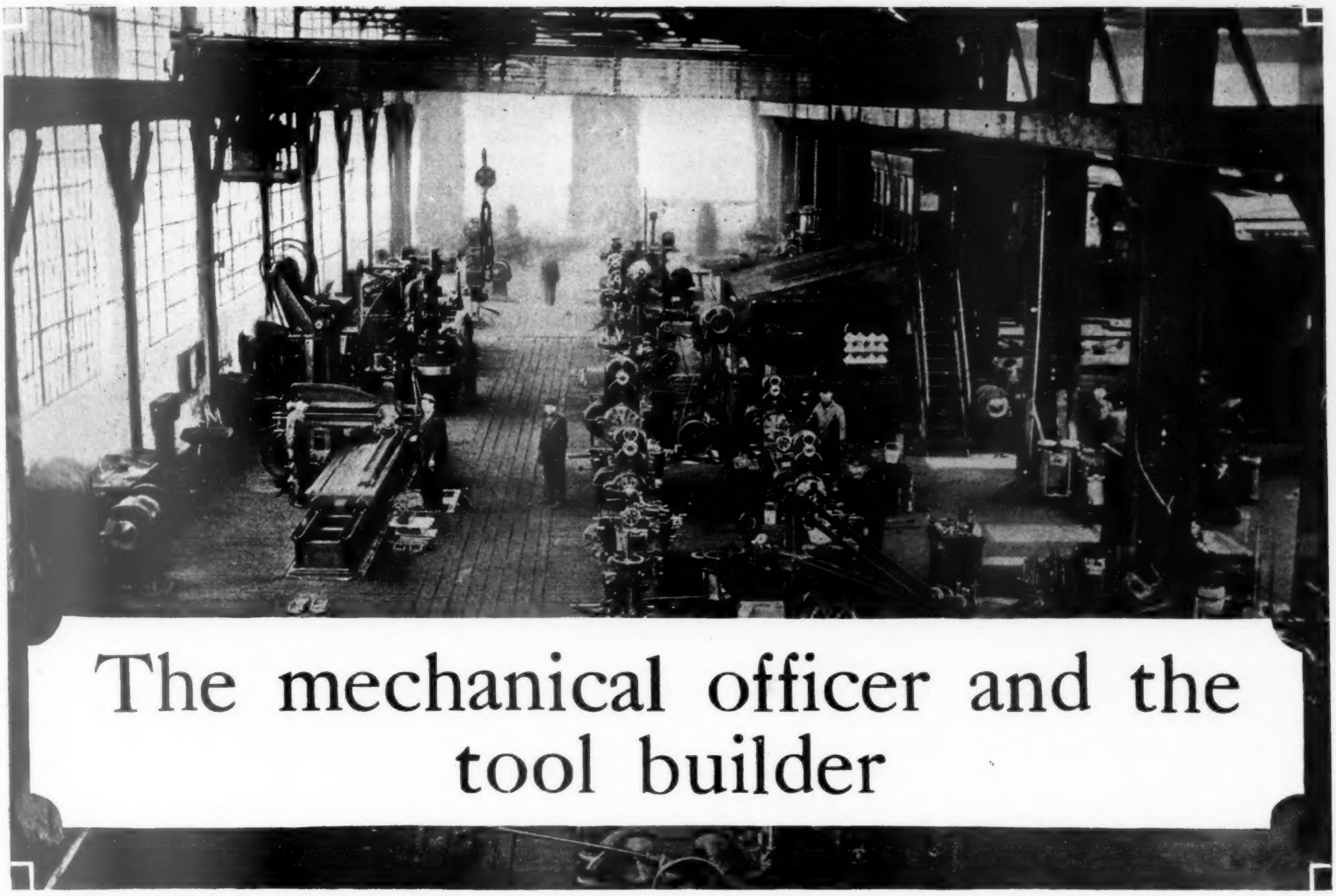
THE device shown in the sketch is used in testing locomotive feed-water heaters equipped with "Y" connections in the branch pipe for the purpose of washing out the feed-water heater. It has been the practice in recent years to equip feed-water heaters with these "Y" connections, particularly in territories having bad water. The fitting shown in the sketch may be used on either the condensate line where it returns to the tank, or on the feed-water pump supply pipe.

It is the usual practice to test the feed-water heater at the time of the monthly inspection of the locomotive. This is done by closing the locomotive boiler check stop valve and opening the condensate valve. Water is pumped into the feed-water heater under pressure through a tapped hole in the end of the heater, which is plugged when not in use, or through a tapped hole located just above the flanged connection to the branch pipe. Water coming out of the condensate valve at the front of the tank or under the cab, indicates a leak in the heater tubes. This procedure is also followed in cases where the heater has the condensate pipe returning to the feed-water pump supply line. In testing this type of equipment the locomotive tank valve is closed tight. Water from the condensate valve might indicate that there is a leak in the feed-water heater tubes or that water is passing by the feed-water pump valves and back through the supply pipe. However, if the fitting shown in the sketch is screwed into the connection of the branch pipe leading to the heater, water from the condensate valve will show that the leak is due to a bad feed-water heater tube.



Nozzle for testing feed-water heaters of the closed type

In cases where the equipment has the condensate pipe returning to the supply pipe of the feed-water pump, with no "Y" connection in the branch pipe, the heater can be tested by blanking the branch pipe leading to the pump or breaking a joint of the condensate pipe between the heater and the supply pipe.



The mechanical officer and the tool builder

Some possibilities for co-operation as seen from the viewpoint of the machine tool industry

By E. F. DuBrul

General Manager, National Machine Tool Builders Association, Cincinnati, Ohio

ALL business is necessarily a matter of co-operation. In small scale, localized business co-operation is between individual producers and users. As the business of the world expands, co-operation extends as between larger and larger economic units, and between greater and greater numbers of units. In time, numbers of independently acting units are gathered into various sorts of associations for the purpose of securing better co-operation. Through such associations the common problems of whole industries are co-operatively studied and solved. Such problems are not solely the internal problems of the industry, but also those that require attention in the mass because of contacts with other industries and interests.

Without such organizations to present the broad industry problem, whole industries suffer waste because their natural co-laborers are not informed of the possibilities of better co-operation. The railroads themselves have been conspicuous sufferers at the hands of the public because of failure to organize along broad lines of industry co-operation. Through co-operation between industry organizations the common problems of diverse industries are studied and solved to bring about still closer co-operation, and thereby to make still more effective the use of the man power of the world.

Through its association, the machine tool industry is continuously collecting, classifying, studying and distributing information and seeking to promote group co-operation with industries using machine tools. Some of the information coming to the association deals with conditions met in selling machine tools to railroads. Some of these conditions could well be modified, to the great benefit of the railroads themselves. The following remarks are not universally applicable to all roads, of course. But they do reflect conditions that are common enough to be of interest to the readers of *Railway Mechanical Engineer*.

Buying machine tool value, not price

Too many railroads buy machine tools on price as the main factor. Where definite specifications can be made, and goods checked against them, then price is a heavy factor. The lower price, all other conditions being equal, should command the business. But, in buying a machine tool one buys an individualized product. No two manufacturers build tools that are identical in structure. To decide sensibly as between two similar machines many things must be taken into consideration before one can really say that Tool *A* at its price is preferable to Tool *B* at its price. This determination is an engineering function. If a purchasing policy is established to the neglect of this engineering function, railroad's shop efficiency suffers to an extent that is of essential interest to the public that pays the bill.

It is to the common interest of the roads, the public and

the machine tool industry that railroad purchases of machine tools be made on the engineering basis, and not on the mere basis of price. Therefore, it is the duty of mechanical department officers, in co-operation with the organized machine tool industry, to devise scientific engineering methods of purchasing.

Some roads may have a really scientific basis of scoring or otherwise weighing the various factors on which the relative merits of similar machines are finally judged. If so, it would be to the benefit of all railroads to have such methods studied and standardized. If there are such definite methods of scoring they are in force on very few railroads. In most cases where the mechanical department has the actual power of decision, the decision is made by "general impression" rather than by definite scoring. The mechanical men "like" such and such a machine more than they do another similar one, but they seldom put the reasons for their likes and dislikes down on paper. In other words, they do not definitely analyze and "score" the machines one against the other. Naturally, when the purchasing or financial authorities want to know why they are asked to pay more for one machine than is asked for another, the mechanical officer is at a loss for an answer, if he has not gone at the matter in a cold blooded, engineering way.

I know it is not going to be easy to devise any scoring system. But I also know that unless and until it is devised, any road's mechanical department will buy on impressions rather than on classified facts that can be defended when the price looks too big to the purchasing department. It seems to me to be up to the railway mechanical department officers to devise good methods of applying engineering methods to railroad buying of machine tools and to call the organized machine tool industry's engineers into consultation on the problem.

Internal consultations and explanations

Reports frequently reach us that subordinates in railroad shops have asked for certain tools, but that the superior officers have given them something else—without explanation as to why the subordinate's request was not complied with. Now, while there are probably good reasons for the change, I submit that it is not good management to leave the subordinate in ignorance of those reasons. To be given something other than the tool he had recommended, without being told why his recommendation was not approved, is sure to cause him to lose interest and initiative, and to become a "buck-passer."

Use the machine tool builders' service

Many mechanical officers seem to lack appreciation of the value of the consulting service that many machine tool builders gladly place at the disposal of their customers. If they do not use this service, their shop management is less efficient than it should be.

Some mechanical officers seem to think that such offers of service are merely schemes for "putting something over" on the mechanical department. Now, any man with that idea is certainly not of the engineering type; he is not open minded to learn all the facts that will help him in running his own job. There is much criticism of the efficiency of railroad shops and much of this criticism is justified. It will harm any mechanical officer and his road if he closes his ears to this general criticism. To close his doors to able men who are desirous of helping him, is itself to say the least, a confession of incompetence. Machine tool engineers can show the shop supervisors many a good way of reducing costs of repairs by better tooling or handling of machine tools now in their shops. The only thing "put over" in such cases, is something to the direct benefit of the men served, because it makes them better railway men.

If the machine tool builder is willing to study a given job, and present definite data as to production and cost, any competent engineer can then determine whether the new methods would be profitable or not. There can be nothing sinister or suspicious in desiring to submit data from which a determination can be made as to a probable economy. On the other hand, there is something suspicious in a refusal to permit such submittal. It is perfectly natural to ask, "Why should a man refuse to consider such data unless he is trying to cover up something?" Is he so incompetent that he cannot judge of the facts such data might show? Or is he opposed to the presentation of facts for fear that they might damage him in the eyes of his superiors? Or are there other sinister reasons for his opposition?

The mechanical officer should, like Cæsar's wife, be above suspicion of any such reasons and therefore he cannot afford to reject service of great value, offered to him by machine tool builders. Nor should he neglect to use such data when received.

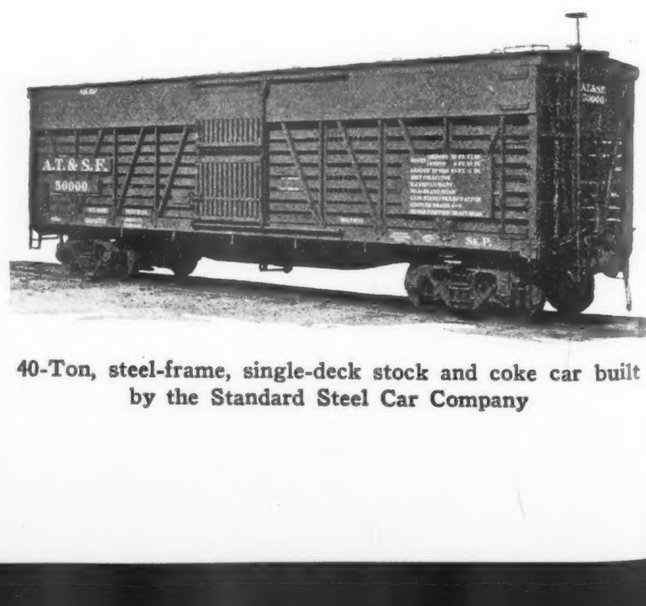
In offering such service the machine tool builder realizes that his own profit must come in making tools that are profit making investments for their users. He has to sell the profitableness of the tool to a competent buyer as the first step in selling the tool. Unless he can demonstrate "Profit" he cannot sell the tool. When he does demonstrate "Profit," the buyer purchases the tool merely as an incidental means for securing the "Profit." The competent builder and seller of machine tools is prepared to demonstrate "Profit" in a scientific impersonal engineering report wherever he can find "Profit" to exist for the user. Any mechanical officer who asks for this demonstration has done full duty by himself, his profession, his company and the public.

A duty to the public

The railroad business is one charged with a peculiar public interest, as we all know. That public interest demands that railway operation and management shall be efficient in every department so that the public shall pay the lowest rates for service consistent with the principle of a fair return on the railroads' property value. So it is the duty of the railway mechanical departments to use all available means to reduce the costs of maintaining the equipment entrusted to their care. The two things herein suggested will play some part in this reduction of maintenance costs. They are:

1. Devise and use definite scientific, engineering methods in purchasing machine tools.

2. Make free use of the production engineering service offered by machine tool builders to improve shop methods.



40-Ton, steel-frame, single-deck stock and coke car built by the Standard Steel Car Company

A modern freight car repair shop

Southern completes plant at Finley—New equipment helps to increase production.

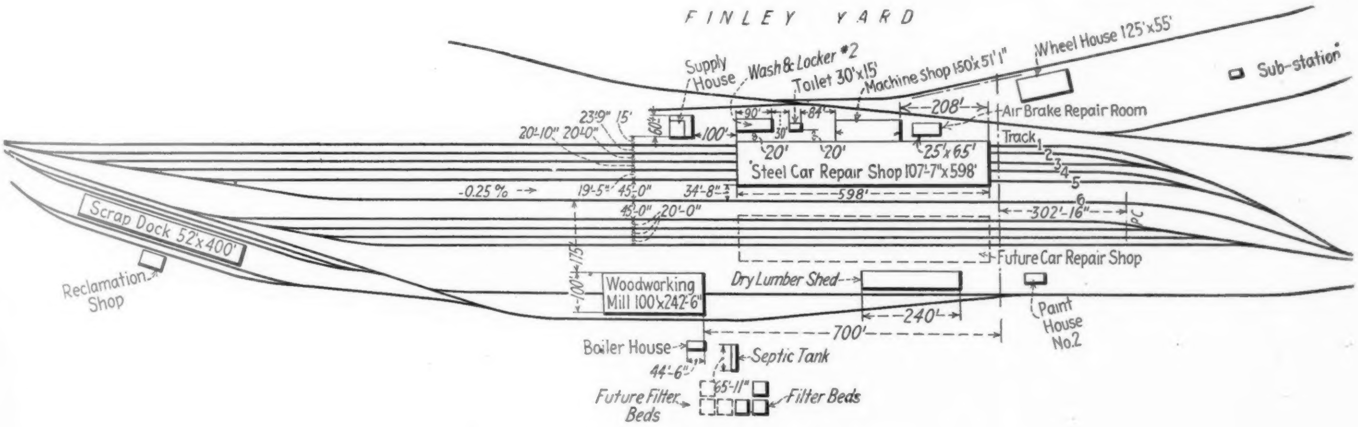
By James Marshall Plaskitt

Mechanical engineer, Finley shops, Southern Railway, Birmingham, Ala.

On December 1, 1924, the freight car repair shops of the Southern Railway System were moved from Avondale, near Birmingham, Ala., to the new Finley shops at North Birmingham. The installation at Finley consists of both a car and locomotive repair shop, and also a 25-stall enginehouse which has been in operation for a number of years. The entire plant, the locomotive unit of which was described in the March, 1925, issue of the *Railway Mechanical Engineer*, is under the direct supervision of the master mechanic, to whom the general foreman of car repairs reports.

Practically the same scheme of administration as used for the locomotive shops is used in the management of the car shops. The master mechanic presides over joint meetings of the foremen in the car and locomotive departments. At these meetings policies to be established that affect the plant as a whole are outlined and discussed, errors and misunderstandings relative to handling the work are corrected and various suggestions for improving production are talked over. Weekly meetings are also held by the general foreman of car repairs with all the car department supervisors at which the program of performing the work is discussed, constructive suggestions and criticisms are received and the work is outlined for the coming week.

Daily progress reports are sent to the master mechanic each morning by the general foreman of car repairs. These reports contain a summary of the progress of the previous day's work in the entire Birmingham territory and they show the bad order cars awaiting repairs at all stations, the bad order cars repaired the previous day, cars painted the previous day, cars recommended for retirement or reconstruction, and the total number of men engaged in repairing cars. Similar figures are also compiled for foreign cars and included in the totals. In addition, the master mechanic keeps in personal touch with the progress of the work through frequent daily inspections.



Layout of the car repair tracks and buildings

The various department heads and their assistants are held rigidly responsible for the work under their supervision. The frequent staff meetings serve to clear up matters of doubt and also acquaint the foremen with the various developments in their particular fields.

It is evident, from what has been accomplished during the short period of time these shops have been in operation, that it was a wise step to abolish the use of antiquated

equipment in favor of more modern types, even though it required a large capital expenditure. A large repair point in the Birmingham territory is necessary for the Southern Railway System. Approximately 3,000 freight cars are handled in its terminals daily and this territory embodies one of the largest interchange points in the South. Interchange is made with the Birmingham Belt, the Atlanta, Birmingham & Atlantic, the St. Louis-San Francisco, the Birmingham Southern, the Central of Georgia, the Seaboard Air Line, the Illinois Central and the Louisville & Nashville.

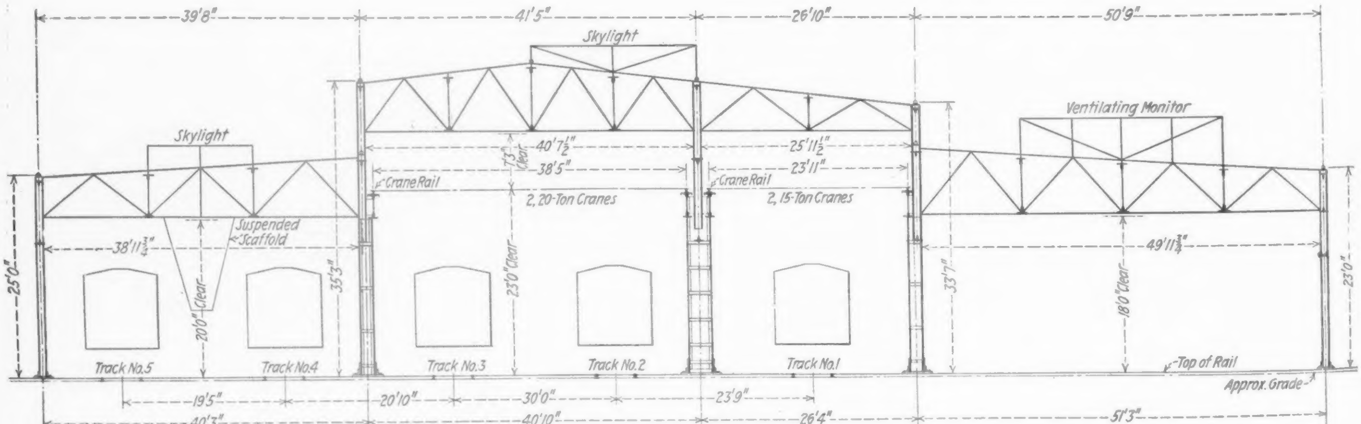
Design and location of buildings facilitates production

The Finley shops occupy a tract of about 100 acres, the locomotive and car repair units being separated by sufficient ground to permit expansion should future requirements demand it. Referring to the cross-section drawing, the car repair shop is an open type shed built of structural steel and rests on a concrete foundation. It is 598 ft. long by 107 ft. 7 in. wide and is built with three bays containing five longitudinal tracks. Track No. 1 is served by two overhead electric cranes of 15-ton capacity. Tracks No. 2 and No. 3 are served by cranes of the same type but of 20-ton capacity. These three tracks are used for heavy overhauling or general repair work while tracks No. 4 and No. 5 are used for finishing, such as completing the carpenter and light metal work on box cars. Permanent scaffolding, secured to the roof girders as shown in one of the illustrations, is located along tracks No. 4 and No. 5. It is hung so that the floor of the scaffolding is located at a height about half way up the side of the average box car body.

Table I—Machinery installed in the fabricating shop

No. of machines	Description
3	Acme double-head bolt cutters
1	36-in. Niles-Bement-Pond vertical drill press
1	5-ft. Dresses Machine Tool Co. radial drill
1	8-in. by 48-in. grindstone
1	Single head pipe threading machine
1	Cleveland Punch & Shear Works punch
1	Cleveland Punch & Shear Works shear
1	10-in. Southern railway pneumatic flanging clamp
1	500-lb. Bradley hammer
1	Buffalo Forge Co. blower
1	Southern railway pneumatic coupler yoke riveter
1	8-ft. Southern railway open forge
1	60-in. Southern railway open fire

Permanent scaffolds on tracks No. 4 and No. 5



Cross section of the car repair shed

Referring to the layout drawing of the car shops, it will be noted that the machine shop is a part of the car repair shop building, conveniently located midway along the No. 1 track side. It is 158 ft. long by 51 ft. wide and opens directly into the car repair shed. This arrangement permits efficient handling of material from the machine shop to tracks No. 1, No. 2 and No. 3, where the general repair work on all-steel cars is performed. Considerable attention has been given to providing suitable and adequate machine tools, a list of which is shown in Table I.

The entire building, including the machine shop, is well lighted. Steel sash skylights in the roof of the car repair shed and standard steel sash windows in the walls, provide excellent lighting conditions during the day. Pyle-National 1,000-watt flood lights are placed at the ends of the car repair shop, as shown in one of the illustrations, to provide light for the yard tracks in both directions leading away from the shed. Drop lights are placed at regular intervals within the building. These lights afford sufficient light for a full force at times when the work demands a night shift. Air manifolds and electric drops to serve the pneumatic and electric tools are located at the columns.

Wheel shop is well equipped

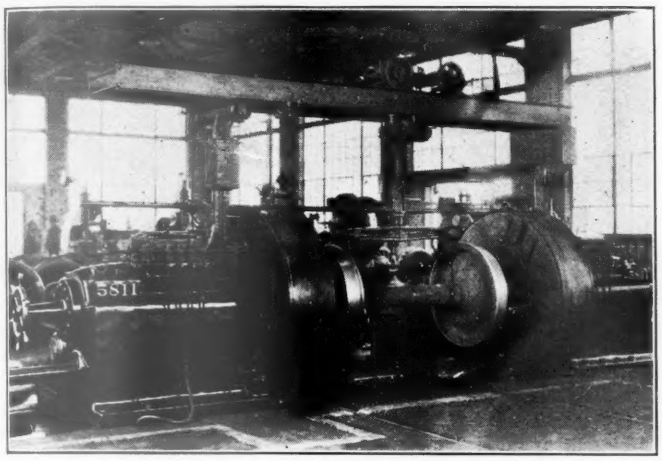
The wheel shop is of brick and concrete construction, 125 ft. long by 55 ft. 10 in. wide and is located northeast of the steel car repair shop. The floor is made of creosoted wooden blocks laid on a concrete base. The building is heated by a system of individual units which utilizes the exhaust steam from the power plant. Unit heaters are placed along the walls and along the interior lines of columns of the various shop buildings.

This shop is well equipped with machine tools, as shown in Table II, for the efficient handling of wheels and axles. The track located to the north of the building is used for

the transportation of wheels to the repair tracks. This track also serves the main and auxiliary storehouses.

The wood working mill

The wood working mill is a large, modern, steel frame and brick concrete structure, measuring 100 ft. by 242 ft. The floor is of wood block laid on concrete and is free from columns, steel trusses of 100 ft. span being used for the roof structure. The side and end walls are almost entirely of steel sash which, in addition to a large monitor has insured ample natural light. A track has been laid along the longitudinal center line with connections at each end to the car repair yard tracks. Some of the wood working equipment was transferred from the old shop at Avondale; however, a large part of the machines are new. A list of the machine tools installed in the wood mill is shown in Table III.



Turning steel wheels in the wheel shop

The arrangement of machine tools and equipment in the wood mill has been carefully planned so as to avoid any back-tracking or re-handling as material is routed through the shop. It is possible to handle all lumber from the dock at one end and route it directly through the mill to the opposite end for delivery to the lumber shed, which is shown in an illustration on page 340.

In the manufacture of side sills, the lumber is passed through an opening in the end wall of the mill from the dock directly to the four-side timber dresser or planer. It is next routed to the cut-off saw, layout benches, and thence to the two-spindle boring machine, where it is bored. Upon completion of this operation, it is routed to the tenoning machine, after which it is loaded and sent to the car repair shop. Practically the same route is followed in the case of end sills, except they are sent to the gainer after leaving the layout benches and from there to the combination hollow spindle mortiser.

Table II—Machine tools installed in the wheel shop

No. of machines	Description
1	48-in. Putnam boring mill
1	48-in. Niles-Bement-Pond car wheel boring mill
1	26-in. by 14-ft. Niles-Bement-Pond axle lathe
1	Safety Emery Wheel Co. emery wheel grinder, motor drive
1	300-ton Niles-Bement-Pond car wheel press
1	52-in. Niles-Bement-Pond heavy duty coach wheel lathe
1	200-ton Niles-Bement-Pond wheel press

Side doors are assembled at the east end of the mill where a steel-top table is located. The machines used in this work are arranged in close proximity to the table on which the doors are assembled and the nails are automatically clinched on the steel top as they are driven. The bottom iron structure or side door bottom guide, made from scrap flues in the blacksmith shop, are also applied here. Bearings 1¾ in. thick are left on the side door bottom guide strips by the blacksmith shop. These bearings function as wedges for the car door so that a tight fit is insured when the door is closed. The utilization of scrap flues for this purpose is a considerable saving.

A conveying system for removing shavings is now being installed. It is to be so arranged that it will collect the shavings at the various machines as fast as they accumulate. All shavings and wood waste material are used for fuel at the auxiliary power house which is located at the southeastern end of the wood mill, as shown in the layout drawing of the car repair tracks and buildings.

Exterior view of the car repair shed showing the location of the flood lights—Track No. 5 at the extreme right

The dry lumber shed is located east of the wood working mill as shown in the layout drawing of the car repair tracks and buildings. It is of heavy timber construction, boarded at the ends and measures 41 ft. by 241 ft., thus

providing ample storage space. Its location makes it readily accessible for the delivery of material to the wood mill or the car repair shop as well as for the reception of lumber shipments.

Storage and delivery of material

The main storehouse and office building is located adjacent to the locomotive unit. One end of this building,

Table III—Machine tools installed in the wood mill

No. of machines	Description
1	Berry & Orton band saw
1	Atlantic Works swinging cut-off saw
1	Atlantic filing and setting bench
1	Milwaukee Sander Co. knife grinder
1	Manning, Maxwell & Moore saw gunning machine
1	Fay & Egan combination band resaw
1	Fay & Egan surface sander
1	Berry & Orton sill tenoning machine
1	Fay & Egan mortiser and boring machine
1	Fay & Egan car gainer
1	Fay & Egan three-spindle boring machine
1	Fay & Egan rip saw
1	L. Power & Co. pony planer
1	Double spindle shaper
1	Small single-head sash and blind tenoning machine
1	33-in. by 60-in. rip saw
1	Berry & Orton railway cut-off saw
2	Fay & Egan planers
1	Singer sewing machine for upholstery work
1	No. 10 S. A. Woods Machine Co. large planer

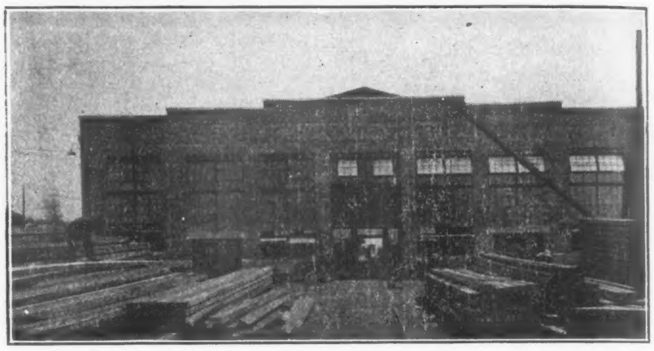
which was described in the March, 1925, *Railway Mechanical Engineer,* is devoted to the offices of the master mechanic, division storekeeper and the other to the store room. The administration of the stores department for both the car and locomotive departments is handled from this office. A sub-storehouse or supply house is located northwest of the car repair shop. This building was formerly used at the Finley enginehouse and was moved to its present location when the new car shops were constructed. It is of frame construction. The system used for storing material is similar to the one used in the main storehouse. Casting docks are provided west of the building and delivery of the material from the sub-storehouse and casting yard to the car repair shop is handled by means of Ford

Interior view of the wood working mill

tractors and trailers. The same system of delivery is used for handling lumber from the dry lumber shed to the wood working mill as well as for the delivery of all material to the crews working in the car repair shop. Special attention is given to the handling of supplies to see that they operate efficiently and that material is always at hand when needed.

Complete facilities are provided for painting

The paint shop is located immediately east of the dry lumber shed and alongside of the same track. The building is of brick and concrete construction and contains two rooms separated by fireproof doors. One room contains the tanks for paint mixing oils and paint storage, while the other room is used for stencil racks, car painting records and a screen drying rack, and is equipped with work benches and easels for sign painting and special jobs. As shown in one of the illustrations, the stencil racks consist of several panels or doors hinged at the back which may be swung open or closed as desired. An entire set of stencils for each class of freight cars is hung on a side of each of the panels. The idea is much the same as



View of the lumber docks and the west end of the wood mill

the picture files seen in many art galleries and the racks provide a unique and convenient method for keeping the stencils filed. A blackboard record is kept of the individual cars that are painted and stencilled so that all work may be credited properly to the material and labor charges.

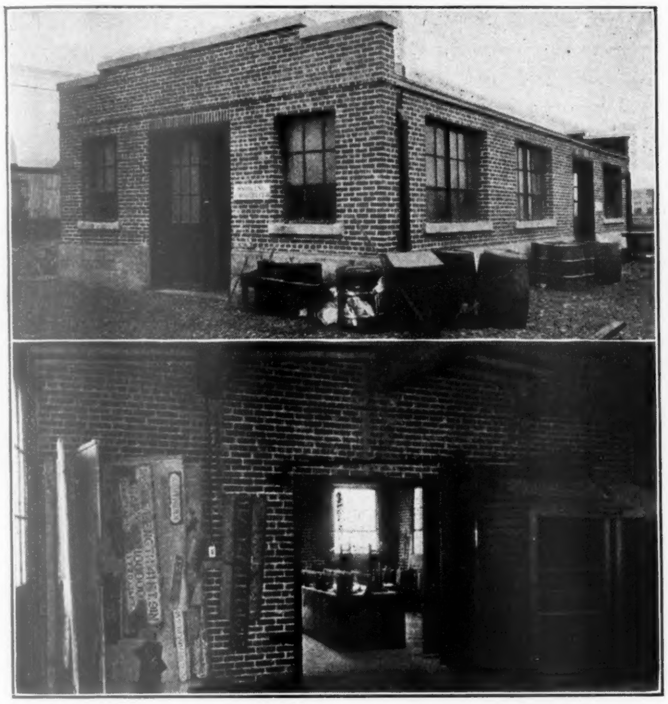
This paint shop is operated as an auxiliary to the main paint shop which is located in the locomotive unit. Practically all of the painting is performed mechanically, the cars being switched from the outgoing tracks of the car repair shop to the tracks east of the car repair shop. After the work of painting and stenciling has been completed, the cars are weighed, inspected and switched out at the west end of the car repair yard to be placed in service.

Method of handling repairs through the shop—Steel underframe box cars

At the present time the management has appropriated funds for the application of 80 steel underframes per month to box cars at the Finley shops. These appropriations are based on a certain fixed amount inclusive of labor and material for each car and the shop is not permitted to exceed a certain specified amount for the performance

of this work. In addition to the work of installing steel underframes, there is a considerable amount of heavy repair work to perform on steel and other freight cars, such as the conversion of beer and ice cars to box cars and the overhauling of coaches.

Light and running repairs are handled on the five tracks adjacent to the car repair shop. They have a combined capacity of approximately 200 cars. In addition, the repair tracks west of the car repair shop, having a capacity of 100 cars, can also be used for this work. The light repair tracks are usually "worked out" once a day. Provisions have been made for performing a certain amount of light repair work in the Finley yards and at the Thirty-Sixth street yards at Birmingham and also at 10 car repair points located at various stations throughout the Birmingham territory. Reports are forwarded by the car repair men at the various repair points throughout this territory to the office of the general foreman of car repairs at Finley. His office is located near the wood working mill and three billing repair clerks are employed to check the records and complete the billing repair cards for foreign lines in accordance with the American Railway Association interchange rules.



Above—Exterior view of the paint shop; Below—Interior view of the work room showing the stencil racks at the left

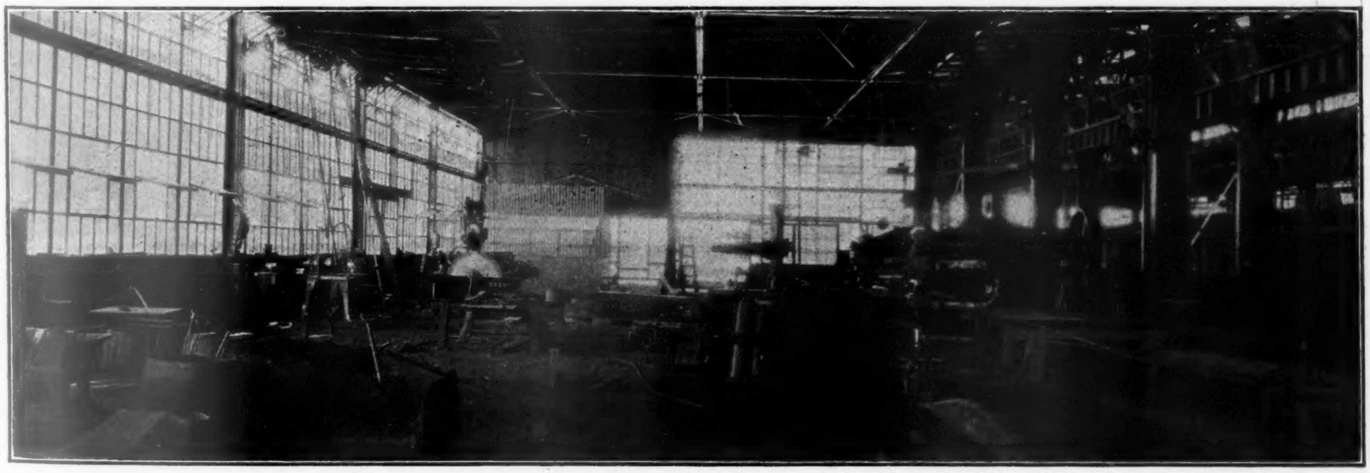
Applying steel underframes

Bad ordered cars suitable for the application of steel underframes are switched to the car department as required. All work is performed with a view to restoring 100 per cent mileage to the cars. For this reason, it is necessary to make all of the required body repairs, repairs to the safety appliances, air brakes, foundation brake gear, trucks, etc., before the car leaves the shop. The work of stripping the decayed or otherwise defective material is performed as far as possible on the stripping tracks outside of the car repair shop. The amount of work necessary varies according to the actual condition of the car. After stripping, cuts of 12 cars are placed on tracks No. 2 or No. 3 or both, as deemed advisable. It is the usual practice to assign two men from the body and truck crews respectively to each car.

One of the illustrations shows the various operations performed on an individual box car receiving a steel underframe. This work is usually handled in the following manner. The body is lifted clear of the trucks by means of two 20-ton overhead cranes, each of which is provided with a steel cable sling. The trucks are then run forward just clear of the body and are spaced at the correct distance to receive the steel underframe. The car body is then lowered on two trestles and the body crew releases the cranes and proceeds with the work of repair. As soon as the cranes are released from the body, they are used to lift the steel underframe from storage and carry it to position over the trucks. The underframe is then lowered and placed on the trucks, the center pins are applied and secured. The next operation is applying the nailing sills to the steel underframe. As soon as this work is completed, the car body is then lifted clear of the trestles, moved forward and lowered in position on the steel underframe. Mention should be made of the fact that the underframe is not applied to the trucks until the truck crew has completed the work of repairs on the trucks.

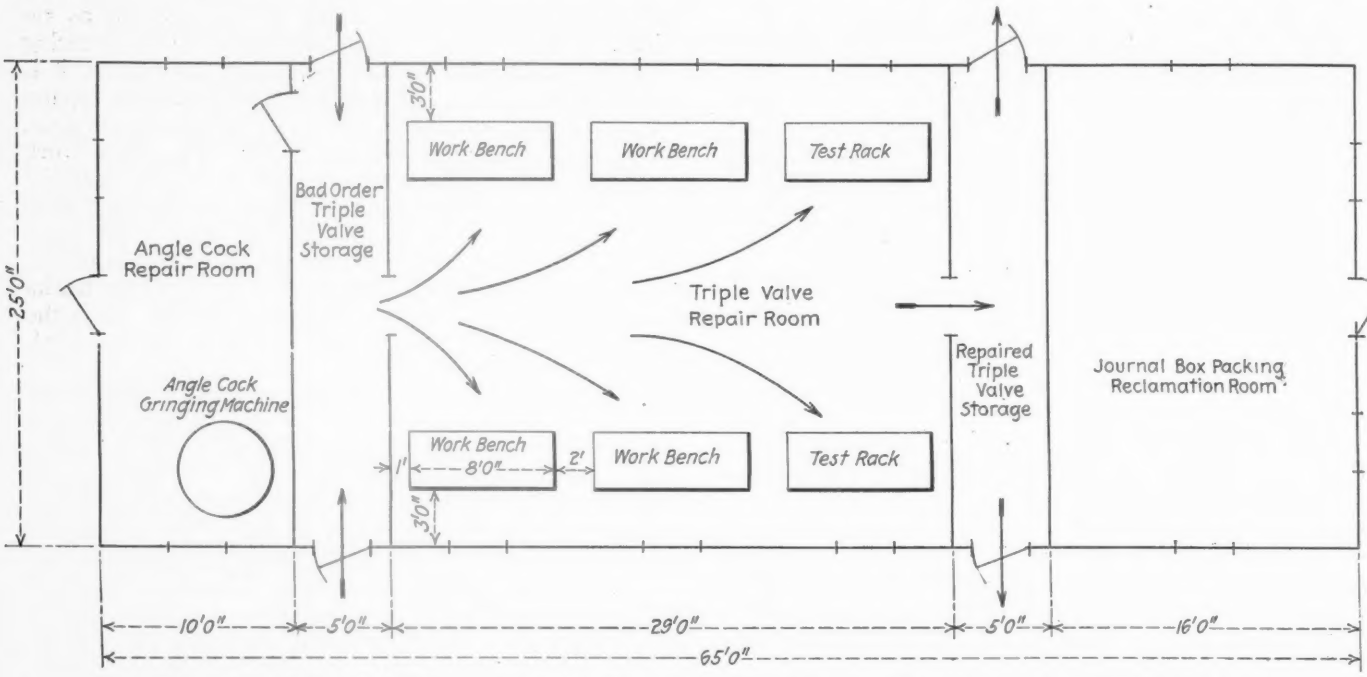
After the body has been lowered in position on the steel underframe, it is fitted with down rods and secured to the underframe. When the entire truck is fitted with underframes, it is shifted to track No. 4 or No. 5, the crews following through for the finishing work, and the body repairs are then completed. The sequence of operations for body repairs is shown on page 339.

All repair work is performed as far as possible in the car repair shop. As soon as a cut of cars has been com-



Interior view of the steel fabricating shop

pleted, they are switched to one of the paint tracks at the east end of the shed adjacent to the paint shop. Here the cars are given two coats of paint by the mechanical process and are then moved to track No. 6, where the cars are stenciled. After a thorough inspection, the cut is marked O.K. for service and is then switched to the Finley transportation yard where the cars are weighed and placed in service. In the case of heavy repairs, where steel underframes are not applied, the operations are practically the same as far as the routing and methods of crane service are concerned. On account of having the service of the two overhead cranes for tracks No. 2 and No. 3, it was found impossible to install a permanent scaffolding, as was done for the finishing tracks No. 4 and No. 5. However, temporary scaffolds are erected and nailed to the car bodies. The loss of time in preparing this temporary arrangement does not materially decrease the efficiency of the work on these tracks. It is believed that this decrease will be eliminated by the utilization of sling scaffolding.



Floor plan of the air brake repair room—The arrows show the routing of the work through the shop

Heavy repairs to all-steel cars

Steel cars requiring general overhauling are placed on track No. 1 in the car repair shop. Little, if any, stripping is done before the cars are switched into the shed, as in the case of wooden freight cars, because of the ease with which the cranes can assist in this work. The various operations used in making repairs to steel cars may be summerized as follows: After the cars are switched to track No. 1, the stripping is accomplished with the assistance of the two cranes. Damaged and corroded parts are removed by the acetylene cutting torch when necessary. Steel parts, such as truck sides, bolsters, draft gears, brake beams and hangers are reclaimed by welding or are sent to the machine shop bay nearby for renewal or repairs as may be deemed necessary. All air

Interior view of the air brake repair room

Sequence of operations performed on a box car receiving a steel underframe

Fig. 1—After preliminary stripping; Fig. 2—Siding removed and trucks being run forward; Fig. 3—Body ready for repairs; Fig. 4—Lowering underframe onto the trucks; Fig. 5—Lowering body onto the underframe; Fig. 6—Applying the siding; Fig. 7—Repair work completed; Fig. 8—Painted and ready for service.

brake and piping work, including that of box and other freight cars, is classified and performed strictly in accordance with A. R. A. requirements. Truck repairs are performed by special gangs. A body gang usually consists of two car repair men and helpers, who remove or apply all the necessary steel to the body. After the work of repair has been completed, the cars are then switched in cuts to the paint tracks. The work of painting, stenciling and weighing is performed in practically the same manner as for the box cars.

System for handling air brake repairs for the car shop

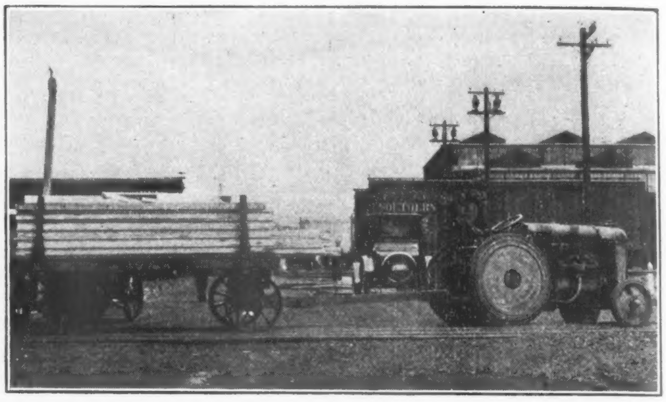
A feature of the car repair work at Finley is the air brake repair department which is located north of the car repair shop adjacent to the machine shop. The building is constructed entirely of scrap beams, sills, siding and planking that has been removed from old cars. The cost of construction was, therefore, quite low. The windows were taken from an old coach. Referring to the floor plan of the air brake room, the building is 25 ft. wide by 65 ft. long. It is divided into three rooms, the first of which is used for the reclamation and grinding of angle cocks. The center room, which is the largest, is used as the triple valve repair and test room. The third room is used for the reclamation of journal box packing and is not connected with the air brake department.

The triple valve repair and test room contains four work benches and two test racks. Bad order triple valves are brought into the room and placed on a storage rack which is located along the wall next to the angle cock repair room. The routing of the triple valves through the repair room is shown by the arrows. Upon completion of the

Above—The dry lumber shed—Below—The casting docks west of the sub-storehouse

work of repairing and testing, the triple valves are placed in a second storage rack at the opposite end of the room, from which valves can be removed as needed. The work benches are of steel, manufactured in the boiler shop, and are of a construction similar to those used in the air brake department of the locomotive unit. The angle cock repair room has two entrances, one of which leads into the triple valve repair room and the other is an outside entrance located at the end of the building. Bad order angle cocks may be routed through the same entrance as that used for bad order triple valves, and directly into the air brake repair room. Repaired angle cocks are routed through the outside entrance without any interference with the work. A multiple angle cock grinding machine is used for grinding angle cocks, located as shown in the floor plan.

Considerable attention is paid to the work of air brake repairs. The general air brake foreman presides over meetings of the staff, at which information and instruction relative to air brake maintenance is given. The proper methods to be employed as well as the recording of the various operations of the Rules of Interchange are discussed at these meetings. Weekly classes of instruc-



Material is handled by trailers and Ford tractors

tion are also held in order to better acquaint the men with the correct methods employed in the repair and maintenance of air brakes.

The journal box packing reclamation room is equipped entirely with shop-built machines and vats for the work of reclamation. It has a concrete floor and is provided with suitable connections for steam which is used in the process of reclamation.

Excellent comfort facilities are provided for the workmen

A wash and locker room is located in a separate building of brick and concrete construction, convenient to the car repair shop. The locker room is arranged with double rows of high steel lockers and ample space is provided at the opposite end where washing facilities for the men have been installed. A convenient feature of the lockers is that they have been built high enough to hang suits or overcoats in them without having to be folded. A separate building for the toilets is located approximately midway between the wash and locker building and the machine shop.

Adequate facilities have also been provided for protection against fire. A number of hose reel carts have been placed in small buildings of wooden construction located in a convenient position to the fire plugs. A sign placed over the door of each hose house gives instructions as to the location of the fire as indicated by the number of blasts of the fire whistle. Supplementary to the fire fighting equipment is an excellent departmental organization. Weekly fire drills are held at unexpected periods and at one of these tests recently conducted three streams were turned on the tank shop of the locomotive unit in 1 min. 30 sec. after the alarm had been given.

Administration

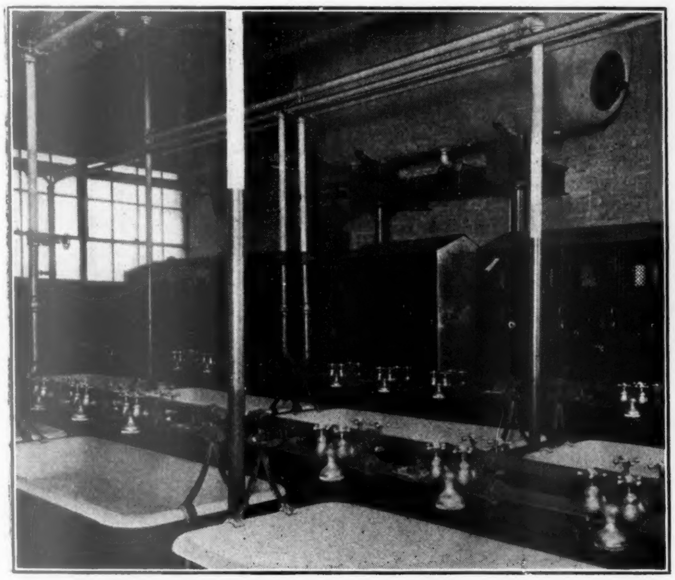
It is a policy of the administration to keep a close watch on expenditures. The system in vogue is based on the amount expended for labor and material for all repair work performed. In issuing authority for addition and

betterment work, such as the application of steel underframes or the conversion of cars from one type to another, a separate appropriation is assigned and an accurate record is kept of the labor and material expended on each individual car. All requisitions for material must show the station at which the work is being done, the number of the car and to what appropriation the amount expended should be charged. In addition to this material record, a labor record is kept by charging the workman's time against each individual car. Credit is allowed for all material scrapped and deductions are made for all scrap and second-hand material.

All the general work is charged to foreign and system car accounts as required by maintenance of equipment department instructions. A careful check is kept in the master mechanic's office as to the progress and cost of repairs from these sources. By means of this check the possibility of exceeding the appropriation is practically eliminated.

Co-operation between the men and supervisory forces has been an important factor

As stated in a preceding paragraph the results that have already been obtained during the short period of operation



Interior of the wash and locker room—The lockers can accommodate overcoats or suits without folding

of the Finley car shops show a considerable decrease in the cost of production over that of the old shops at Avondale. No small share of the credit can be given to the spirit of co-operation and interest that has been shown by the men and the supervisory forces in bringing about the record that has already been achieved. C. E. Keever, master mechanic of the Finley shops, has created an excellent spirit of co-operation and progressiveness in both the car and locomotive departments. The shops were laid out under the general direction of H. W. Miller, vice-president, the engineering details being handled by B. Herman, chief engineer. The machine tool and mechanical department details were planned under the direction of R. L. Ettenger, mechanical assistant to the vice-president. The development of the plans and construction for the car shops as well as the locomotive shops, described on page 165 of the March issue of the *Railway Mechanical Engineer* were carried forward by Dwight P. Robinson & Co., Inc., New York.

A convenient whistle valve test rack

By Frank Bentley

THE accompanying illustration shows a conveniently arranged whistle valve test rack. Above the rack, but not shown in the illustration, is the drum for the air volume, out of one end of which leads the pipe carrying the necessary car discharge valve with the restricted orifice. The chain to the discharge valve, which is shown at the left, is pulleyed so that the handle attached to it may be pulled while watching the timing clock to the right. The testing whistle and the wrench for removing the diaphragm case under examination are never lost or misplaced as they are kept at the rack by small chains fastened to the wall. For the convenience of the operator the instructions for testing are framed and secured to the wall

Compact, permanent arrangement for testing whistle valves

to the left. The gage for observing the pressure is directly above the valve cap bracket and cap which are permanent parts of the rack equipment.

ONE HOUR, twenty-four minutes was the time required recently by H. W. Lehr's crew, at the Thirty-second street repair shop of the Pennsylvania Railroad, at Pittsburgh, Pa., to take out the 12 wheels of a dining car and put other wheels in their places. This was in an emergency when a diner which had started on a special run from Philadelphia to San Francisco had its wheels flattened, because of an emergency application of the brakes, at a point east of Pittsburgh. Mr. Lehr's crew consisted of A. C. Hussong, A. Dawidowicz, J. Bruszak, J. Pavlovic, M. Dvorabic, J. Koss, J. Starkowitz, F. Pasko, P. Sikora, C. Belancey, P. Starkowitz, R. Cillo, J. Stacherski, J. Lujic, J. Majkut, L. M. Bauer, J. Kozak, G. W. Euler, F. C. Johnson, J. Grosiak, A. Teofilak and S. Pluto. The train waited for the car.

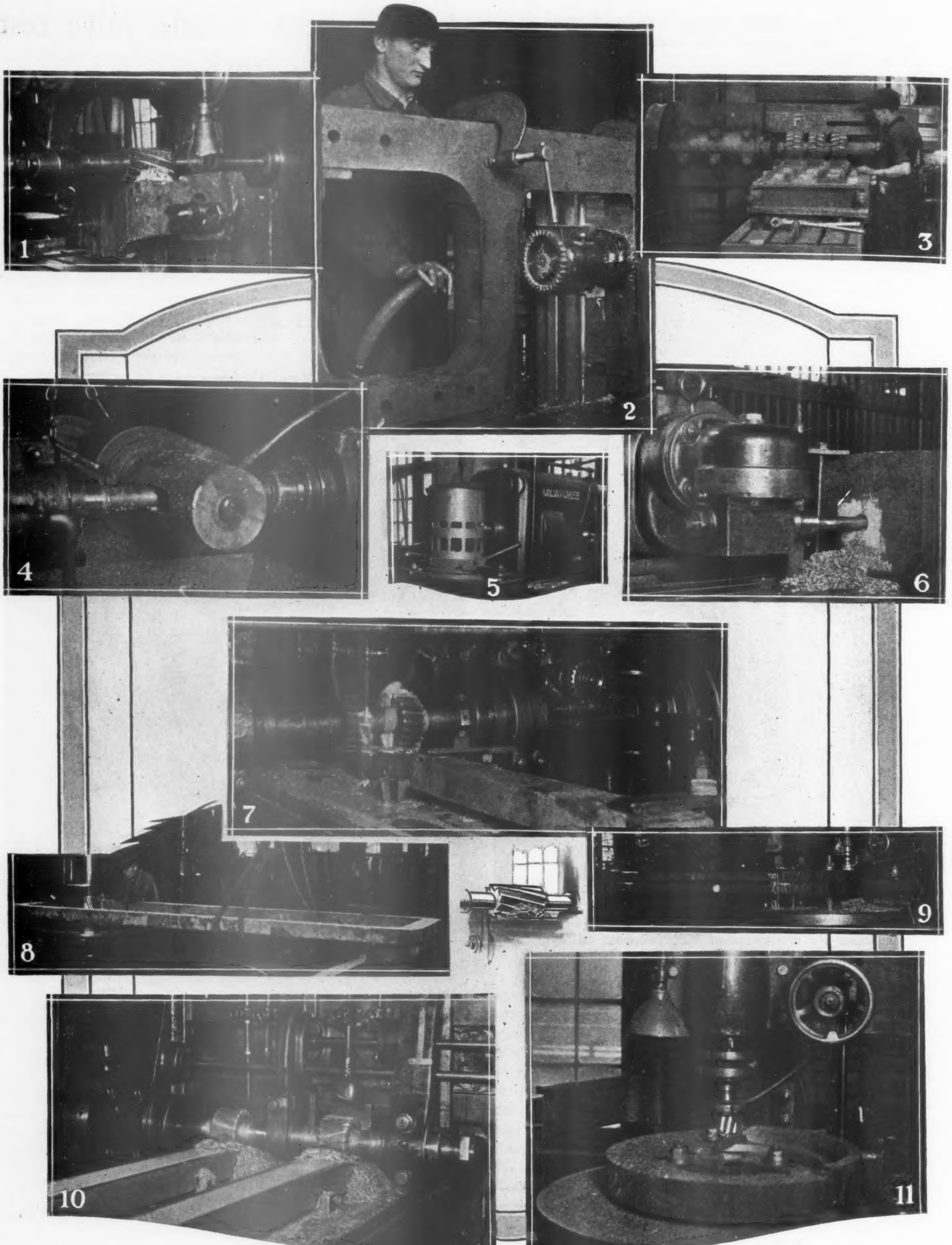


Fig. 1—Milling contour of eccentric crank arm; Fig. 2—Facing driving box pedestal jaws; Fig. 3—Milling crosshead shoes; Fig. 4—Milling keyway in piston rod, using a helical cutter; Fig. 5—Middling ports in valve chamber bushing, using an end mill; Fig. 6—Cutting a die on a milling machine, using a special attachment; Fig. 7—Milling sides of crosshead guide, using a straddle cutter; Fig. 8—Milling the corners of a mud ring on a vertical miller; Fig. 9—Profiling the ends of two main rods at one set up; Fig. 10—Cutting channels in two main rods on a horizontal miller; Fig. 11—Milling the fit in a piston head rim

Milling machines in railway shops

Classes of work for which they are fitted, cutters of proper design and lubrication are important considerations

By Leroy R. Gurley

SEVERAL articles appeared in the *Railway Mechanical Engineer* in 1917 and 1918, dealing with the subject of milling machines in railroad shops. Without exception the introductory paragraphs of these articles lamented the fact that the railroads were backward in more generally applying milling processes to certain classes of work. The articles were enthusiastic over the possibilities of the economies effected by machining certain classes of work on milling machines which then were usually done on the planer, shaper or slotter.

On investigation of present day milling machine practice in railroad shops over that of eight years ago, it has been found that the railroads have appreciated its possibilities and are applying its principles to the work for which it is suited. Within the past eight years, various sizes of horizontal and vertical millers have been placed on the market for handling large pieces of work such as rod and link motion work. This work was formerly done on the planer or slotter. However, this does not mean that the milling machine is always more effective than the planer or slotter, because for many operations these machines are better adapted. When single parts are to be machined, the time required to set up and perform the operation on a planer is less than when setting up the work on a milling machine and getting milling cutters of the required shape and size to perform the work. For the quantity production of many duplicate parts, however, the milling machine cannot be equalled.

Types of milling machines used in railroad shops

The milling machine was originally developed for manufacturing the small, irregular shaped parts used in the construction of fire arms and the milling process is still employed very extensively in the production of similar work, especially when the parts must be interchangeable. Milling machines are used for a great variety of operations and many types have been designed for finishing specific classes of work to the best advantage. They are widely used at the present time in the railway shops for milling many large castings or forgings which were formerly finished exclusively by planing; in fact, it is sometimes difficult to determine whether certain parts should be planed or milled to secure the best results.

The four principal types of milling machines used in the railway shops are the plain, universal, horizontal and vertical. The names used distinguish different classes of milling machines and indicate some additional feature that is characteristic or they may relate to the nature of the work for which the machine is intended.

Plain milling machine.—This type has a horizontal cutter spindle and is of the column and knee construction, which means that there is a vertical column, and a knee which is fitted to guiding ways on the face of the column, to provide vertical adjustments for the work table. Plain milling machines are commonly used for milling operations which can be performed by feeding the work in a straight line either vertically or in a horizontal plane, although in modern practice there are many exceptions to this rule. In the last few years, a number of improvements have been made in the plain milling machine that have added to its adaptability for railroad work and the two more important of these are greater power to drive the cutters to the limit and quicker methods for changing speeds and feed so that either can be readily adjusted for any particular part to be machined. These two improvements are especially valuable in railroad work, because a long run on one job cannot be expected.

Universal milling machine.—A universal type of milling machine is so named because it is adapted to a very wide range of milling operations. Its construction is similar to that of a plain milling machine although a universal type has certain attachments which plain machines do not ordinarily have, that make it possible to mill a large variety of work. This type has a knee which can be moved vertically on the column and a table with both cross and longitudinal movements. There is a difference, however, in the method of mounting the table on the knee. The table of a plain machine is carried by a saddle which is free to move laterally but does not permit the swiveling of the table. The swiveling base of the saddle of the universal machine makes it possible to do work such as helical milling which can not be done on a plain machine unless a spiral milling attachment were used that provides an angular attachment for the cutter. Practically all machines of this type are equipped with auxiliary appliances such as the dividing or indexing head, vertical milling attachments, etc. The universal milling machine is usually found in the tool room of the railroad shops.

Horizontal milling machine.—Any milling machine equipped with a horizontal spindle may be classified as a horizontal type but this name is generally applied to designs which have a horizontal work table, like that of a planer, and a horizontal cutter spindle. There are exceptions, however, to this classification. When a machine has a horizontal work table and bed, but is equipped with vertical spindles, it is termed by some manufacturers "a vertical spindle, horizontal machine." When the horizontal design of the planer type has a single spindle carried by a column at one side of the work table, it is sometimes known as the open side type or as a single spindle side head type. A machine designed in this way is also called a rotary planer, especially intended for milling plain surfaces or for slabing operations by using a large inserted tooth cutter head. This type of machine is generally used for heavy milling operations such as milling and fluting main and side rods.

Vertical milling machines.—When an end mill is driven directly by inserting it in a spindle of the plain type, it is difficult to mill some surfaces, especially if much hand manipulation is required, because the mill operates on the rear side of the work where it cannot readily be seen when one is in the required position for controlling the machine; moreover, it is frequently necessary to clamp the work against an angle plate to locate it in a vertical position or at right angles to the end mill when the latter is driven by a horizontal spindle to overcome these objectionable features. Special vertical milling machines have been designated. These machines are usually designated as

adjustable rotary milling machines and are especially adaptable in the railroad shop for such work as rod ending, strap profile milling and milling out side rods.

Milling processes

Some of the more general milling operations are classified either in accordance with the type of milling cutter used or the name given. A certain operation may indicate the method of presenting the cutter to the work. For instance, there are operations known as face milling, angular milling, form milling, etc. Some milling operations are associated with a special type of machine, whereas others merely indicate the type of cutter used or a certain method of milling. The following definitions are believed

Fig. 12—Cutters used on milling machines in railroad shops

(1) Large cutter for milling involute gear teeth; (2) Inserted tooth face miller for heavy work; (3) Helical cutter for milling rods; (4) Inserted tooth interlocked cutters for milling shoes and wedges; (5) Spiral inserted tooth end mill; (6) Helical mill of the hole or arbor type; (7) Inserted tooth cutter for channeling main rods; (8) A pair of plain, niched tooth cutters mounted on an arbor; (9) Inserted tooth slab cutters for milling driving rods; (10) Inserted tooth cutters

to conform to general practice, although in some cases there is no generally accepted agreement regarding the use of these terms.

Face milling, as the term is generally used, means the production of a plane surface by the teeth of a milling cutter which operate in a plane at right angles to the axis of the cutter.

Gang milling means that surfaces in different planes are milled simultaneously by a combination or gang of two or more cutters.

End milling is a term usually applied to milling operations requiring an end-mill, as, for example, the cutting of slots, facing narrow surfaces, etc.

Straddle milling is an operation requiring the use of two side milling cutters which are spaced on the arbor a definite distance apart, in order to finish two or more parallel surfaces simultaneously.

Angular milling relates to the machining of surfaces which are at an angle neither perpendicular to nor parallel with the axis of the milling cutter, the teeth of the cutter being inclined the required amount.

Form milling is a method of producing a surface which may either be curved or of irregular shape, by using a formed cutter the teeth or the cutting edges of which conform to the shape required.

Slab milling is a term which is generally understood to mean the machining of comparatively broad flat surfaces, either by means of a cylindrical cutter or a face-mill.

These milling operations are the ones more commonly used on milling machines in the railroad shop. Profiling and routing are operations which are used in the railroad shops only in rare instances.

Milling cutters

To secure the most economical utilization of milling machines, it is imperative that properly designed cutters be used for each milling process. There are many shapes and sizes of cutters, a group of which are shown in Fig. 12, but they may all be classified under a few principal types.

The improvements in milling cutters adapted for railway practice and other work have been remarkable in the last few years and have contributed greatly to the present success of milling. The cutters of a few years ago had teeth spaced from ¼ to ⅜ in. and many are in use today, the faces of the teeth being cut radial from the center. The teeth were generally all straight or only slightly spiral and, except on form cutters or gear cutters, they were rarely ground on the cutting face. It was generally thought that it was necessary to have fine teeth in order to obtain smooth surfaces, but it has been found that the slight irregularities in the finished surface are revolution marks and have no relation to the number of teeth in the cutter. For instance, it has been found that if feeding 1/16 in. per revolution of the cutter, the irregularities or slight depressions in the surface are 1/16 in. apart; if the feed is ⅛ in. feed, then the depressions are ⅛ in. apart, etc.

The cutters now largely employed for flat surface milling have teeth spaced from 1 in. to 1¼ in. and cut a spiral of about 25 deg. The face of the tooth is undercut or given a rake of from 7 to 10 deg., the cutting face and the top of the teeth being ground after hardening. All sharp corners at the bottom of the tooth are avoided. These are essential features of a cutter of maximum strength to cut and remove metal quickly with the least consumption of power, and at the same time to produce a satisfactory finish.

The plain milling cutter is cylindrical in shape, with teeth either straight or spiral. The teeth are generally niched at intervals along the cutting edge to break up the chips. The maximum diameter of these cutters is about 4½ in., above which the inserted tooth type are used.

The side milling cutter, also known as a straddle cutter, because a cutter of this type is frequently used in pairs for straddle milling, are cutters commonly used in railroad practice. This type is provided with teeth on both sides as well as on the periphery of the cylindrical surface. Side milling cutters are used for cutting grooves or slots, as well as for many other operations. They are often used in conjunction with other forms of cutters for milling special shapes in a single operation.

Inserted-teeth milling cutters are widely used in railroad shops. The advantages claimed for this type of cutter are that considerable can be saved in its construction by making the body from machine steel and that the teeth can be readily renewed in case of breakage, which cannot be done with the solid type. The objections to this type of cutter are the difficulty of obtaining sufficient spiral, lack of chip space and liability of breaking the teeth. The latter objection is generally overcome by making the teeth amply large.

End-mills are used in railroad shops for cutting ports in valve chamber bushings and similar work. They are provided with teeth both on the cylindrical surface and on the plain end surface; this permits them to cut in an endwise as well as in a sidewise direction.

Face mills, in railway work, are useful for milling driving box cellars and a number of castings used on the locomotive and tender. They work equally well if made solid or with the inserted teeth. Since, in face milling,

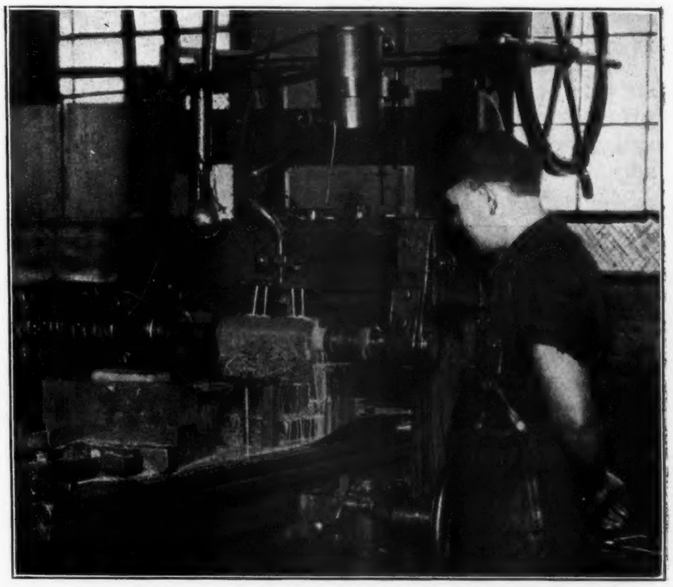


Fig. 13—Milling a link bracket on a horizontal miller with the cutters completely covered with the lubricant

practically all of the cutting is done by the periphery of the cutter, the teeth should have the same degree of rake and angle as the slab mill for rapid cutting.

The helical type of cutter is one which was especially designed for the railroad shop. The shank type is primarily intended for internal finishing, either working from a drilled hole or working in from the end of the piece. The steep spiral with which these cutters are designed gives them a shearing action that enables the cut to be taken easily while maintaining a good finish. At the same time, the undercut teeth contribute to the free cutting action, and require less power for driving. These cutters are generally used in the railway shops on vertical or horizontal millers for cutting out of the solid the back

and front ends of main rods. Fig. 12 shows a group of various types of milling cutters used for different classes of work in the railroad shops.

Grinding cutters

The use of properly ground cutters is especially essential in order to obtain the maximum output of milling machines, and unless this is attended to, high rates of speeds and feeds cannot be expected. Considering for the present the outside of the tooth, it is very necessary that it be ground to give the correct amount of back clearance. Too sharp an angle will cause the cutter to chatter, hook in and produce rough surfaces. Too little clearance will cause the cutter to drag and prevent proper cutting. Many cutters have been condemned on account of too sharp teeth or angle, where a slight removal of the keen edge either by grinding or wear would have remedied the trouble. No hard and fast rule can be given governing the amount of clearance, as different metals will require different degrees. For steel such as used largely in locomotive construction, a back clearance of about three degrees appears to be satisfactory for a 4½-in. cutter. It is a good plan occasionally to measure this back clearance, which can readily be done by a bevel protractor. The data obtained will be available for grinding future cutters. Sheet steel gages made to the proper angle for testing cutters after being ground will be a great help. When a happy medium has been arrived at for grinding the back angle, it will be found that cutters as they come from the grinding machine will start off at once to full capacity without the nursing often necessary with improperly ground cutters. Some of the cutter grinding machines are arranged so that the amount of back clearance can be adjusted.

To grind the front rake of a tooth or the undercut surface is somewhat difficult on the average universal grinding machine, but it can be performed in a fairly satisfactory manner by setting the grinding spindle at right angles to the groove in the cutter and using a cup grinding

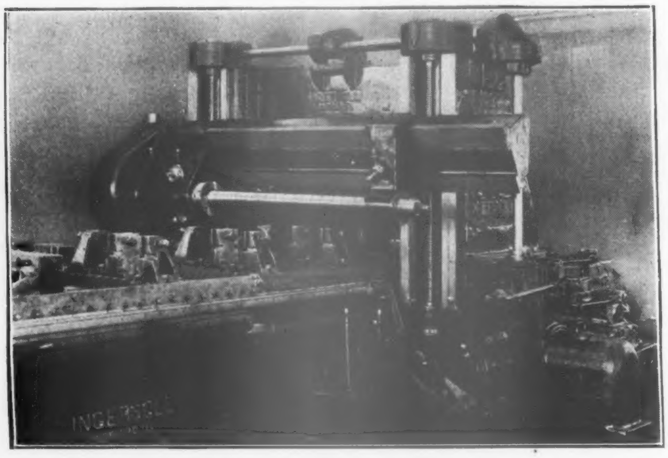


Fig. 14—Fixture for holding almost every style of locomotive driving rod

wheel. The cutter must be passed back and forth holding its face against the wheel. Some of the latter grinding machines are equipped with spiral grinding attachment that will grind this surface nearly perfect. Even with the hand method, however, the results obtained in the way of longer life between grindings, fully justify the additional expense of this one grinding. The grinding of the face of a tooth may be likened to the grinding of the top face of a lathe tool. Who would think of making use of a lathe tool that had not been ground on the face after hardening? A smooth surface is absolutely necessary to prevent the chip dragging on the lathe tool or the cutter tooth face. The question as to how often a cutter should be ground may be answered by observing the chips. When these show a discoloration in spite of a liberal supply of compound it usually indicates that the cutter teeth are either dull or broken.

Lubrication of cutters

One of the greatest factors for efficiency in milling is the proper lubrication of the cutters. Without some good means of cooling, it is impossible to approach the maximum amount of work possible with any design of cutters, because the limit of speed is reached when the cutter burns. It has been demonstrated that the nature of the lubricant is of minor importance so long as a sufficient quantity is provided. The newer milling machines are equipped with a system of lubrication that floods the cutters, which is very effective. Fig. 13 shows a link bracket being milled on a horizontal miller with the cutter completely covered with the lubricant.

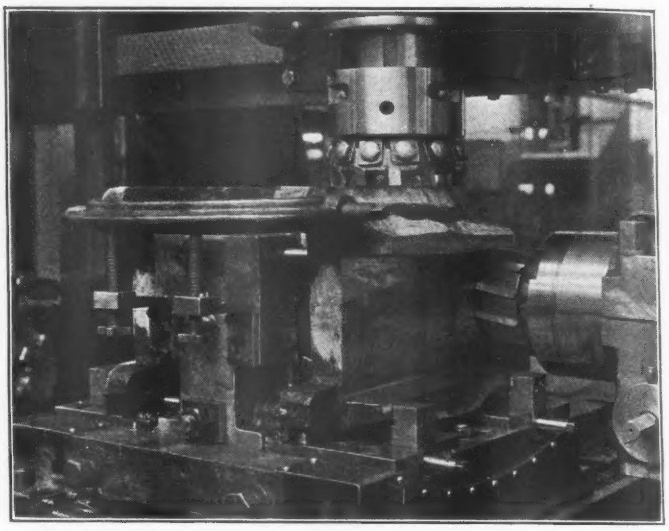


Fig. 15—Special fixture for holding driving boxes while milling three sides simultaneously

Holding fixtures

The use of holding fixtures plays an important part in obtaining the maximum production from milling machines. For single purpose machines, they are indispensable not only in time saved in quickly loading the piece and holding it securely, but by allowing an unskilled workman to operate the machine, as the fixture has fixed points for locating the work when setting up. For general purpose machines, the necessity for the fixture is not so great. However, in nearly every shop, there are certain pieces that are coming to the milling machine from time to time for which it pays to make special fixtures, and there may be a considerable number of pieces not alike, yet somewhat similar, that may be held by combination fixtures made of crossbars, screw jacks side stops and clamps.

It was found for example, on a slab milling machine that the time of loading and setting up locomotive rods without fixtures was greater than the time used in actually milling the work. This situation was corrected by making the combination fixture shown in Fig. 14 which holds almost every style of rod. The special fixture shown in Fig. 15 for holding driving boxes while milling the three sides simultaneously with inserted tooth facing cutters is adjustable to various sizes of boxes.

Milling locomotive parts

The work performed on milling machines can be segre-

gated according to the types of millers. Main and side rods, link motion levers, driving box shoes and wedges, etc., are usually finished on the horizontal or vertical miller, while gears, taps, etc., are completed on the plain or universal millers. The former machines are located in the main part of the repair shops while the latter are generally found in the tool room.

The work now handled by the two heavier types of machines was formerly finished either on the planer, slotter or shaper. Several factors must be considered when transferring the work from older types of machines to the millers. These factors are (a) the large percentage of the total power consumed by the actual cutting of the metal instead of moving the part machined and the machine table back and forth; (b) the continuous cut; (c) the reduction in time required for tool setting and grinding of the tools. The fact cannot be overlooked on the planer, slotter or shaper, that there is only from one to four tools cuting while the milling machine will have from 12 to possibly 26 cutting points. The milling machine cutter, with the greater number of cutting blades, can be removed and replaced in practically the same time it takes for the one tool on the three older types of machines. A comparative time study should be made of performing the work on the different types of machines which would show whether it would be an economical move to transfer the work. Table I shows the time, from floor to floor, of machining various parts on the horizontal and vertical millers.

Table I—Time required for milling locomotive parts on the heavier types of milling machines

	Material	Kind of operation	Cutter speed, r.p.m.	Table feed, in. per min.	Time to complete, hr.	min.
Axle box housing	Cast steel	Mill top and bottom inside faces	38	3⅜	0	25
Connecting rod	Forged steel	Mill from solid, 6-in. by 8-in. brass fit	148 (rough) / 228 (finish)	⅞ / 3¾	1	35
Crosshead	Cast steel	Mill underside, radius and fillet	30	variable	1	35
Crosshead gib	Cast iron	Mill fit	65	7¼	0	35
Crosshead guide	Steel	Mill bottom, top and offsets	60 (rough) / 74 (finish)	2 / 5⅝	4	0
Crosshead guide	Steel	Three faces	16	1⅜	1	30
Driving box cellar	Cast iron	Mill sides	32	4¼	0	14
Driving box fits	Babbitt	Mill both faces	..	4.2	0	12
Driving box wedges	Cast iron	Nine milled inside	..	..	0	45
Driving box wedge	Cast iron	Mill five surface with gang cutter	20	7¼	0	8
Driving box shoe and wedge	Cast steel	Two pieces, finished inside	12	..	0	38
Eccentric blade	Forged steel	Mill top and end	65	7¼	1	38
Eccentric crank	Steel	Mill contour	59	1 3/16	4	0
Facing pedestal jaws	Steel	Both jaws	24	11/16	1	35
Link saddles	Forged steel	Mill to surface	35	½	0	40
Main rod brass	Brass	Mill sides	183	5⅝	0	45
Main rod key	Mild steel	Mill rounded edge	..	..	0	20
Mud ring	Steel	Mill four inside corners	..	..	8	0
Main rod	Steel	Milled on all four sides and fluted	21 (for fluting)	3/16	12	0
Main rods	Steel, H. T.	Profiling both ends of two rods	..	..	10	0
Main rods	Steel, H. T.	Two rods milled complete	..	..	20	0
Piston head rim	Cast iron	Mill fit	..	..	0	35
Piston rod keyway	Steel	Mill 1⅛ in. by 4⅜ in. keyway	..	..	0	55
Side rod	Steel, H. T.	Profile front end	30	1½	0	30
Side rods	Steel	Profile both ends of two rods	..	..	2	45
Side rods	Steel	Mill both ends of two rods	28	1/32	4	0
Spring saddle	Cast steel	Mill feet	38	5⅝	0	9
Trailer spring saddle	Cast steel	Mill bottom, sides, ends and top ends	25	4¼	1	40
Trailer spring saddle guide	Cast steel	Mill fit	41	1⅝	0	28
Union link	Steel	Mill clevis ends	148	2⅜	0	40
Valve bushing	Gun iron	Eight ports	228	4¼	0	45
Valve bushing	Cast iron	Mill 11, 1½-in. by 2¼-in. ports	231	4½	0	30
Valve yoke	Steel	Milling bevel to fit fillet on slide valve	..	..	0	45

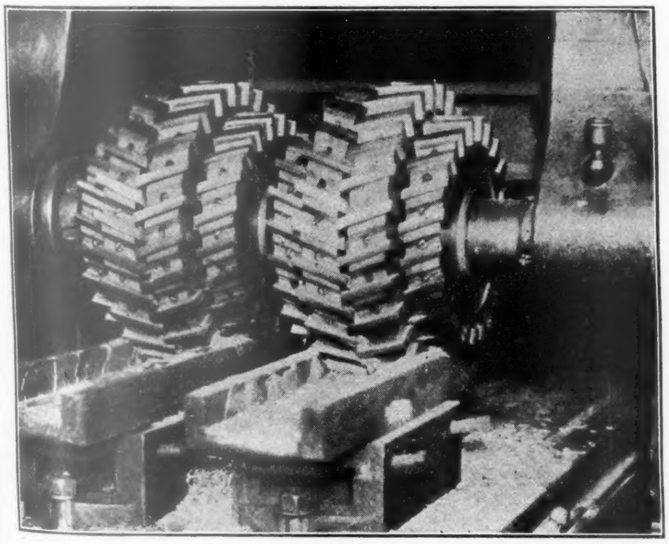


Fig. 16—Milling the guide bar fit of crosshead shoes using a gang of inserted tooth interlocked arbor cutters

The milling of driving box shoes and wedges on a horizontal miller using a gang of inserted tooth cutters is rapidly become general practice in railroad shops. Fig. 16 shows a double row of crosshead shoes being milled using inserted tooth arbor cutters and interlocking side milling cutters. On this machine, 60 shoes have been completed in eight hours. Fig. 3 shows another view of nine wedges set-up in three rows of three each which were finished complete inside, in 45 min.

To obtain the above results, the following factors must be considered. If a perfectly smooth finish is not considered essential, the milling cuts of shoes and wedges can be taken at the fastest speed the cutter will stand. With fairly good forgings and removing not over ¼ in. depth of cut, a cutter speed of 60 ft. per minute and feeds of 3 in. to 6 in. per minute, can be obtained, the rate of feed being largely governed by the ability to hold the wedge on the holding fixture. The thrust from the milling cutters on the wedge is heavy, as from 15 to 20 hp. will be consumed when milling to the limit of modern cutters on a surface of this kind. All the thrust of the cutter must be taken up by the wedge, and unless the piece is well secured, it is liable to shift or slip and damage the cutter. Therefore, it is advisable to make a holding fixture for this work.

After pouring the shoe and wedge face on locomotive driving boxes they must be machined to size. Many of the railroad shops are doing this work on a horizontal miller using two inserted tooth milling cutters. Fig. 17 shows a machine of this type with four boxes set up on the table. Forty boxes per eight-hour day, giving an actual cutting time complete per box of five minutes and a setting up time seven minutes, making a total of 12 min.

from floor to floor for each box, is considered good machine time for this work. The established feed to obtain these results is 40 ft. per min. for cutting speed, and 42 in. per min. for table feed. These speeds and feeds have proved desirable on this class of work as from 80 to 90 boxes may be machined with one grinding of the cutters.

The machining of crosshead shoes can be done to advantage on a horizontal miller. Fig. 18 shows a herring-bone type of crosshead shoe being milled on a horizontal miller. The body of this crosshead shoe is made of cast steel, while the recesses are filled with a soft metal, which gives an unfavorable surface to machine. This condition naturally requires a slower cutting speed. Notwithstanding this drawback, ten crosshead shoes are milled in an eight-hour day, using a table feed of 2 in. per min. and a cutting speed for the largest diameter of cutter of 40 ft. per min. An average of 18 crossheads are machined with one grinding of the cutters.

The machining of main and side rods on either a horizontal or vertical miller is considered the most economical method of doing this work. The rods first have their four sides machined on a

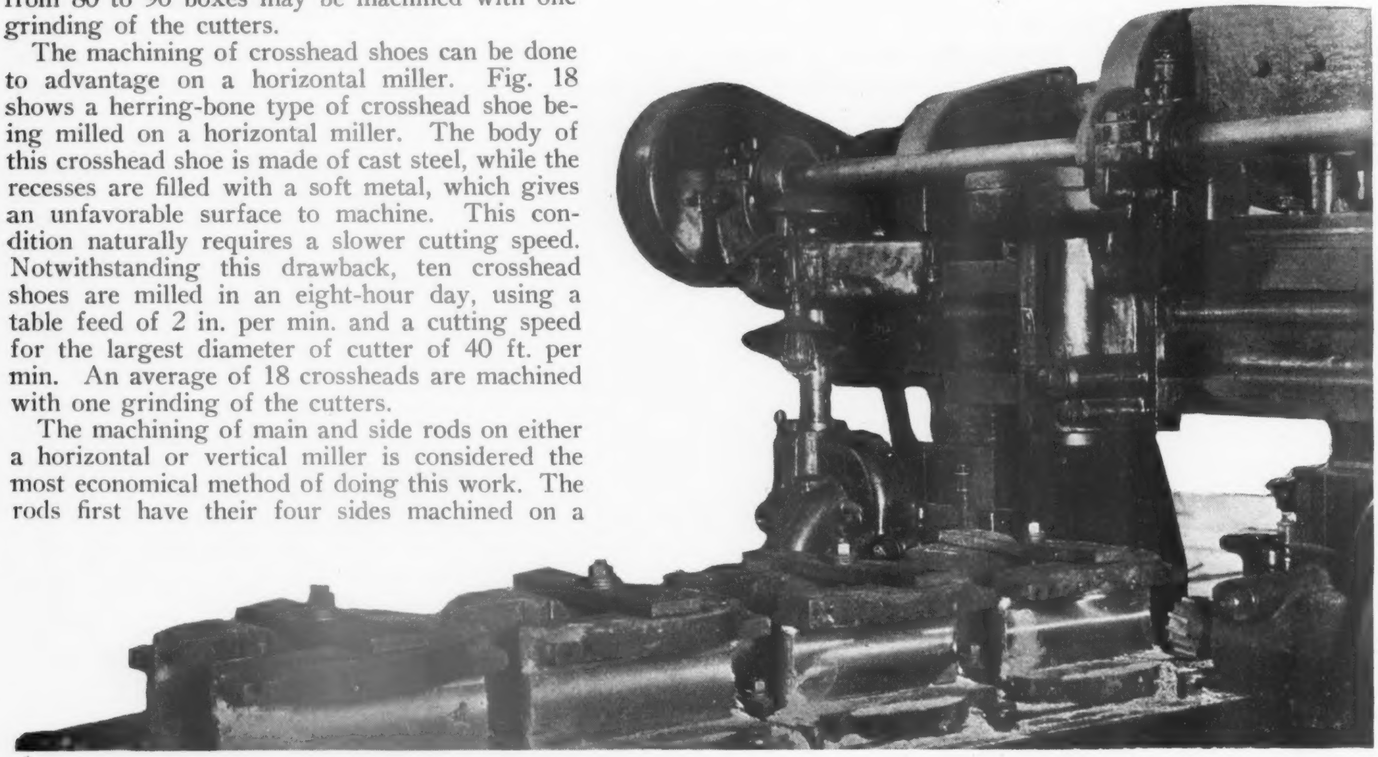


Fig. 17—Milling the shoe and wedge fits of driving boxes using two inserted tooth facing cutters

horizontal miller. From two to six rods can be milled at one set-up, depending on the size of the rods. The next operation is to mill the flutes in the main rod. Fig. 10 shows two rods each having two 7-in. by 12-in. flutes milled complete in 12 hr. The rods were completed throughout in 20 hr. The next operation is to mill out and profile the back and front ends of the main rods and mill the contour of the ends of the side rods. Fig. 9 shows a radial vertical miller machining out the rear end of two main rods in two hours, and the back end in eight hours.

Crosshead guide bars are machined on a horizontal miller, using a gang of inserted tooth cutters. Fig. 7 shows the rough forging of a guide bar, having its two sides milled with a straddle inserted tooth cutter. By using a cutter between the two cutters shown, the top face and two sides can be milled at one operation in 90 min., using a table feed of 1⅜ in., and the cutters revolving at 16 r.p.m. Considerable time is saved by using the three cutters to complete the job in one set up.

The usual method of cutting the keyway in a piston rod is to drill, slot and hand file, which requires about three hours to complete. A milling machine has been designed, which will do this job in less than an hour. Fig. 4 shows a 5½-in. diameter piston rod having milled in it with a helical cutter a 1⅞-in. by 4⅜-in. keyway in 55 min., from floor to floor. This machine will also mill the keyways in crossheads. This is a single purpose machine, and its purchase is justified only for those shops which have a considerable amount of this type of work to do.

It is often necessary to face the pedestal jaws of a locomotive frame. To disassemble the frame and machine it on a planer would be an expensive operation. The pedestal facer shown in Fig. 2 is well adapted for this work. The actual time required to face the pedestal jaws shown in the illustration is as follows:

Set up the machine	15 min.
Facing the wedge side of the pedestal	40 min.
Facing the straight side of the pedestal	35 min.
Taking down the machine	5 min.
Total time	1 hr. 35 min.

A cut 1/16-in. deep was taken which required a cutter speed of 24 r.p.m. and a feed of 11/16-in. per min.

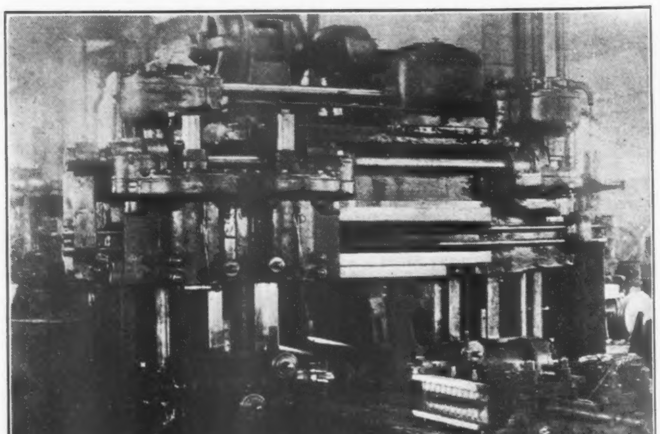


Fig. 18—Milling the guide bar fit on a herringbone type of crosshead

Fig. 11 shows a piston rim ring being milled in 35 min. on a vertical miller using an inserted tooth end mill. Another example of the application of an end mill may be seen in Fig. 5 which shows the milling of the ports

of a valve chamber bushing. This bushing contains 11 ports, 1½ in. by 2¼ in., each port requiring 2½ min. to complete, using a cutting speed of 231 r.p.m. and a feed of 4½ in. per min. By using a chuck which enables the operator to revolve the bushing quickly, the 11 ports were finished complete in 30 min.

The plain type of miller can be used to advantage in the repair shop as well as in the toolroom. Fig. 1 shows a machine of this type milling to the layout line in 4 hr. an eccentric crank using a cutting speed of 59 r.p.m. and a table feed of 13/16 in. per min. Another application of the plain miller may be seen in Fig. 6. By means of a special attachment a steel spring hanger die block in which a 2-in. diameter hole, 6 in. deep had to be milled, was completed in 3 hr.

Fig. 8 shows a vertical miller machining a mud ring which is an unusual job for this machine. The four ends of the mud ring are milled complete in 8 hr. after which it is placed on a planer and finished.

Milling machines in the toolroom

The first application of milling machines in railroad shops was in the toolroom. They were of the universal type and were used for repairing and manufacturing such tools as reamers and taps. Experience has shown that these earlier machines did not have sufficient capacity for handling some of the larger tools used in railroad work. Consequently, the toolrooms have been provided with the larger machines such as is shown in Fig. 19. In addition to regular tool room work, they are used for finishing machine repair parts and making holding fixtures, jigs and other special machine attachments.

Fig. 20 shows a universal machine milling a 4½-in. by 3¼-in., 14-thread hand tap. The same illustration shows a group of cutting tools which were made on this machine. They consist of three staybolt taps, six hand taps, one reamer, one hand bolt tap for frame equalizer spring bolt holes and one general tap. Referring again to Fig. 19 the top right view shows a staybolt tap being completed in 33 min. using a cutting speed of 40 r.p.m. and a table feed of 2 in. per min.

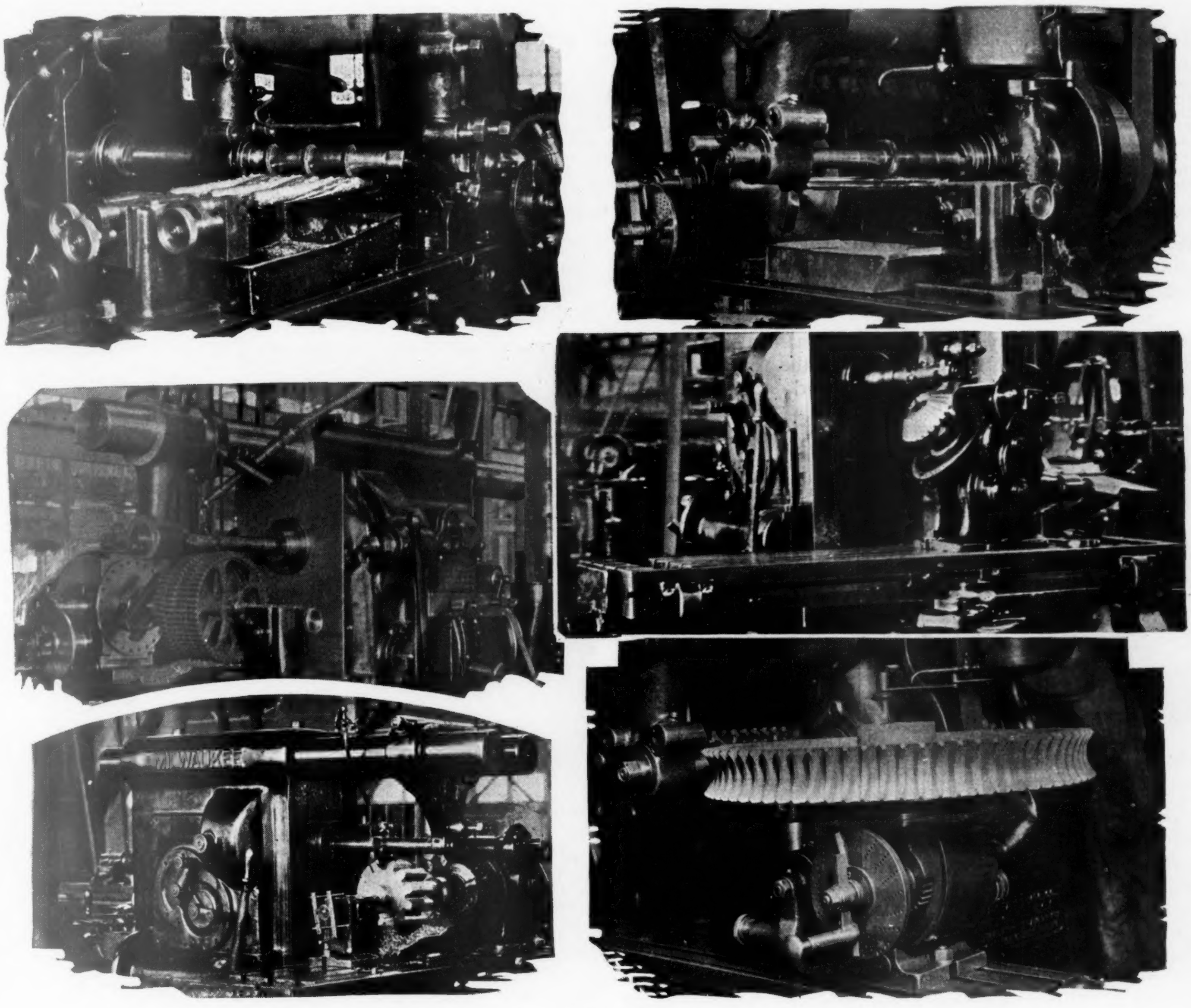


Fig. 19—Various types of jobs performed on milling machines in the railroad toolroom

One of the frequent jobs which a toolroom is required to do is the generating of various types of gears which are a part of a machine or other shop equipment. As these repair jobs are usually urgent, they are made in the toolroom instead of being purchased from a manufacturer.

The left-center view of Fig. 19 shows a universal miller

cutting the teeth in four cast-iron gears in 5 hr. using a cutting speed of 45 r.p.m. and a table feed of 1 in. per min. Each gear has 60 teeth 1 in. wide and .360 in. deep. The right-center view shows a miller cutting the teeth in a bevel gear, using an indexing head. The left-bottom view shows a miller generating the teeth in a heavy spur gear. The right-bottom view shows a universal miller cutting the teeth in the worm gear of a hoisting machine used at a car icing plant. This gear has 75 teeth, each with a 3-in. face and was completed in 12½ hr. The right hand view shows three reamers being milled at one set up.

The illustrations show only a few of the many jobs which can be machined in the toolroom on a plain or universal type of milling machine. The time required for machining other types of cutting tools and gears may be found in Table II.

Table II—Time required for milling cutting tools and gears on the plain or universal milling machine in the toolroom

	Material	Kind of operation	Cutter speed, r.p.m.	Table feed, in. per min.	Time to complete, hr.	Time to complete, min.
Staybolt tap	Carbon steel	Six, 23-in. flutes	40	2	2	33
Hand-tap	Carbon steel	Four, 4½-in. flutes	58	2½	0	32½
Spiral reamers	Carbon steel	Three reamers, nine flutes, 12 in. long	75	.036	0	32
Gears	Cast iron	Four gear, each with 60 teeth, 1 in. wide	45	1	5	0
Worm gear	Cast iron	75, 3-in. teeth	..	..	12	0
Drop forging die	Steel	Mill to size	20	Variable	5	0
Spring hanger dies	Steel	Milled to line	..	..	3	0

Conclusion

The present-day tendency of mechanical department officers is to analyze the conditions in the repair shops so as to segregate certain classes of work and have them machined on machine tools particularly adapted for such work. A striking example of the results of such an analysis is shown in an article which appears elsewhere in this issue on "Rod and valve motion production," in the Aurora, Ill., shops of the Chicago, Burlington & Quincy. The shop was organized for handling new and old rod and valve motion work on a production basis and in which milling machines are extensively used. There are other locomotive and car parts which are now finished on other machines which can be more economically handled on milling machines. However, before changing over to the milling machine it is well to make an exhaustive comparative time study of performing the work on the different types of machines.

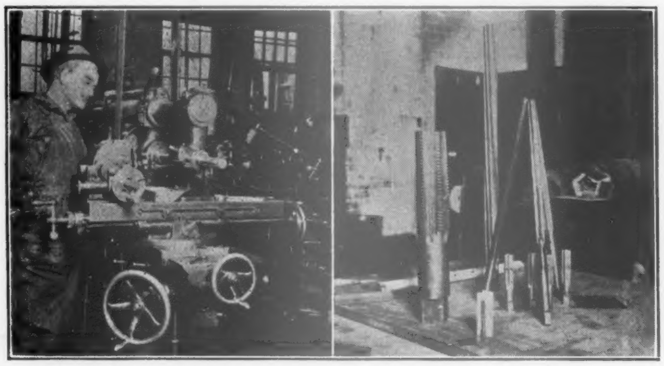


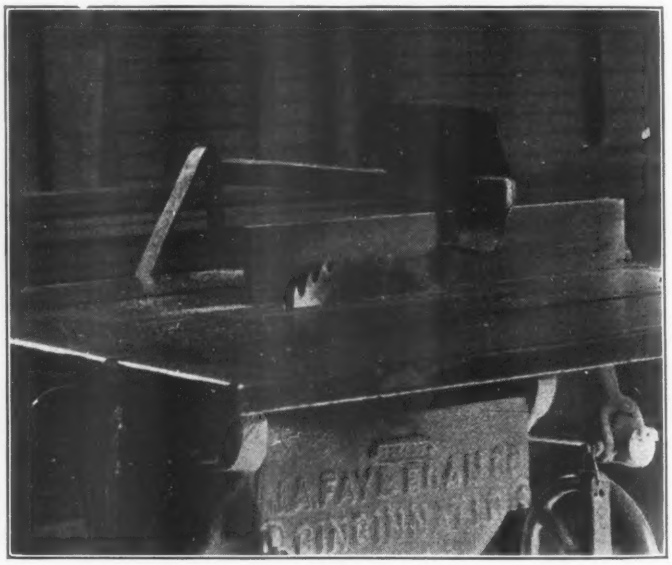
Fig. 20—Milling a hand tap on a universal milling machine—A group of cutting tools which can be made on a machine of this type

In analyzing shop conditions, it is common to find many parts which can be economically manufactured on a single purpose machine. This means that production methods and modern machinery should be installed and, with this thought in mind, the mechanical officers are giving considerable attention to the milling machine as a production tool.

A safety guard for circular saws

ONE of the most dangerous machine tools with which a carpenter has to work is the circular saw. There is always a possibility of a workman allowing his hand to rest too long on the piece he is cutting and receiving a nasty cut. It is practically impossible to use a wire-guard or cage of the usual type as such a safety device interferes with the work and it is usually taken off by the first man who happens to use the saw and finds the guard in the way.

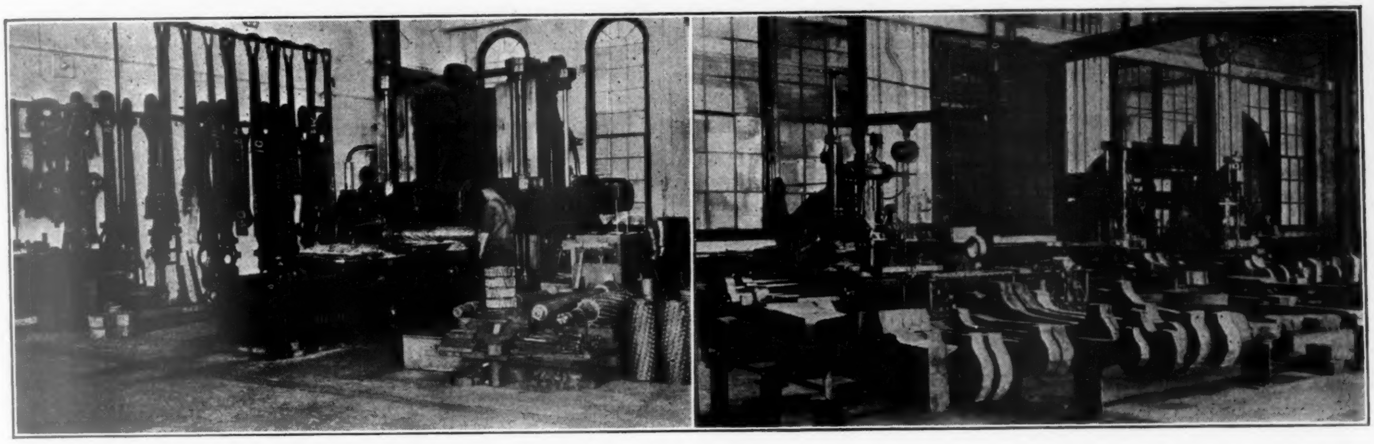
A simple and effective device which has been designed with the special purpose of eliminating these difficulties is shown in the illustration. It consists essentially of a horizontal wood arm pivoted at one end to a bracket secured to the table and a guard of tin projecting upward and a guard of sole leather projecting down at the other end. The tin guard is used to deflect the saw-dust so that it will not fly into the eyes of the workman and the leather guard is used to prevent him from allowing his hand to slide onto the saw, and thus affording protection from possible injury.



The top shield deflects flying saw-dust and the lower shield protects the head of the workman

There is practically no interference of the guard with the work, regardless of the size of the piece to be cut. When large pieces are being cut, the leather guard slides along on the work as it is moved forward past the saw, the sole leather being sufficiently stiff to raise the arm on its pivot.

The Interstate Commerce Commission has granted a petition of the Chicago & Northwestern for exemption from equipping with automatic train control devices the locomotives of its Sioux City division operating between Maple River junction and Carroll, Ia., 3½ miles.

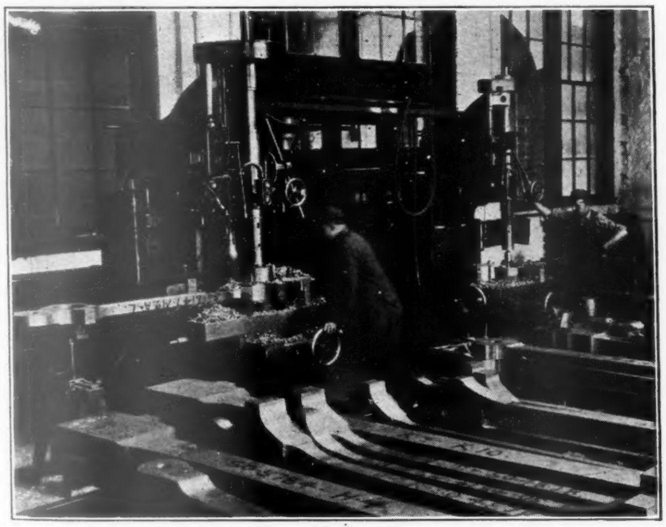


The Burlington rod shop is well lighted, the floor is clean and the work and tools arranged in an orderly manner. (Left) Heavy Ingersoll slab miller roughing out a pair of side rods. (Right) Roughing bench with Ingersoll heavy duty vertical miller and two Baker heavy duty rod drills in the background; overhead traveling crane will later be provided with an electric hoist and electric operation by push button control from the floor

Rod and valve motion production

Burlington organizes separate shop at Aurora, Ill., for handling new rod and valve motion work on a production basis

THE economies due to centralization of manufacturing work in a single plant or shop provided with modern machinery and trained men are well-known, and several railroads have taken advantage of these economies in handling certain phases of their shop work. The Chicago, Burlington & Quincy is believed to be one of the first, however, to organize a separate, fully-equipped shop devoted solely to system locomotive rod and valve motion work. Converted from an old boiler shop, this modern machine shop at Aurora, Ill., was placed in operation January 1, 1925, and, although certain additional machines and electrically-operated cranes are still to be installed, the new shop has already given a good account of itself. With a total force of 10 machine operators, two bench hands, one apprentice and two helpers, the following output was obtained in the first three months of this year: 32 new main rods, 142 new side rods, and heavy repairs to the rods on 60 engines. This shop is designed to manufacture all the new rods required for the entire system. The motion work is handled in one corner of the shop, as shown in the drawing, and, since the development of this part of the work has been somewhat delayed, a description of it will be deferred to a later issue, the present article being devoted primarily to methods of production in the rod shop.



Large holes are cut rapidly and accurately by the Baker drills equipped with three-cutter trepanning tools—Illustration shows a 12-in. hole being cut

New shop converted from old boiler shop

A new building was not erected for this rod shop but advantage was taken of an opportunity to convert the old 112-ft. by 75-ft. boiler shop at Aurora for this purpose. This shop was given a new cement floor, the walls painted white, traveling cranes overhauled, lighting improved, and in general every effort made to produce conditions in the shop most conducive to good output. Modern machinery was then installed, the location and type of each machine being shown in the drawing. The arrangement is such as to eliminate as far as possible all unnecessary movement and back travel of both material and men. The rods follow the course indicated by the dotted line, the forgings being received from the blacksmith shop, machined on the heavy millers, drills and slotter illustrated. completed on the finishing bench and delivered to the stores department for all points on the Burlington System.

The shop is now equipped with hand-operated traveling cranes, there being one over the heavy machines and roughing bench and another over the finishing bench. Plans have been made for the power operation of these cranes by means of push button control from the floor which will make possible a distinct saving in time and labor of handling the rods. Four helpers were required in the old rod shop for handling rods on trucks whereas one man is now able to do all this work in the new shop. In addition to the overhead crane, the heavy vertical spindle miller has a self-contained jib crane to assist in handling the rods for that particular machine. Another 20-ft. jib

crane provided in the corner handles rods for one of the Baker drills as well as the Sellers slotter.

While some old machines were located in the Aurora rod shop temporarily, most of the machinery installed was new, a list being shown in the table, together with those additional machines which will be provided in the 1925 budget.

Machinery installed in Aurora rod shop

No. of machines	Description
1	48-in. by 48-in. by 16-ft. Ingersoll slab milling machine.
1	36-in. by 36-in. by 12-ft. Ingersoll slab milling machine.
1	54-in. Ingersoll heavy-duty vertical milling machine.
1	5-in. Baker heavy-duty rod drill.
1	4-in. Baker heavy-duty rod drill.
1	72-in. Sellers slotter.
1	No. 4 Brown & Sharpe universal milling machine.
1	24-in. Bullard vertical turret lathe.
1	28-in. Cincinnati crank shaper.
1	24-in. by 8-ft. Boye & Emmes engine lathe.
1	C. B. & Q. 75-ton hydraulic rod press.

Additional machines to be installed in rod shop

No. of machines	Description
1	18-in. by 48-in. engine lathe.
1	28-in. heavy-duty crank shaper.
1	¾-in., 2-spindle high-speed drill.
1	3-in. heavy-duty drill.

Factors promoting high production

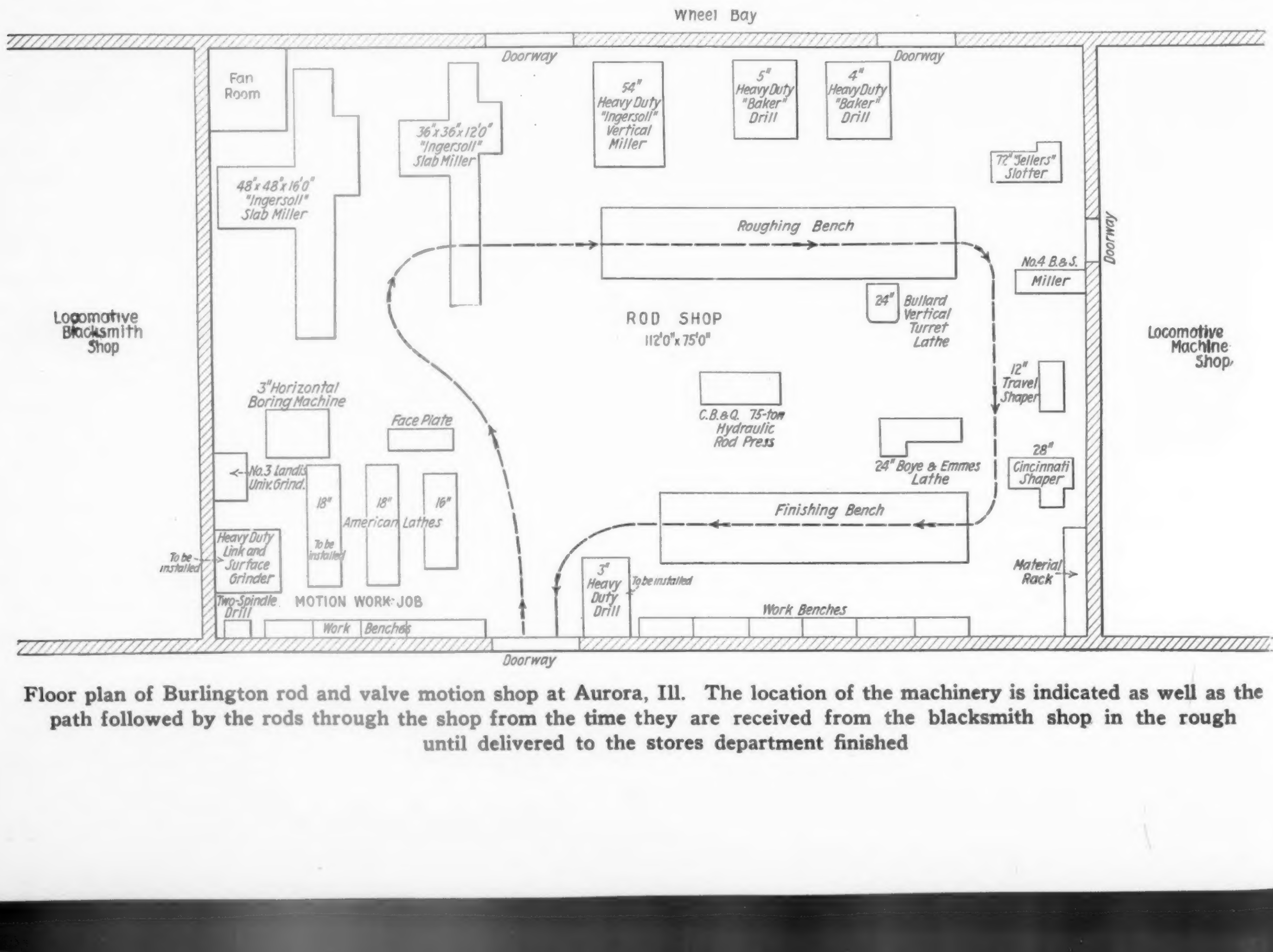
Particular attention is paid to orderliness, neatness and clean floors at the Aurora rod shop in the thought that a better shop output will result, as well as decreased liability of accidents from stumbling over rod straps, brasses, tools and other materials often found laying around in a more or less careless fashion on rod shop floors. Rod racks are made from rails and cast iron stands and tool racks are provided for each machine.

Next to the arrangement of machinery in the shop and provision of proper crane facilities for handling the rods, perhaps the most important single factor in the shop output obtained is the elimination of hand fitting and filing. All rods are finish milled without filing, all brasses, both front and back end, being machined so that practically no hand fitting is required. The accuracy of the machine work and its influence in reducing the amount of hand fitting is indicated by the fact that two mechanics and one apprentice do all the bench work at the Aurora rod shop.

The labor and time involved in laying out is also minimized by the use of templates for new rods and straps. These templates are available for all classes of rods and straps and are kept hanging on the wall of the rod shop, as shown in one of the illustrations, where they are out of the way and there is no danger of their being damaged. It is stated that the use of these templates saves at least 1½ hr. work per rod in laying out.

Burlington 75-ton hylraulic rod bushing press driven by self-contained 3-hp. motor and equipped with single plunger pump—Quick return of the ram is provided

In order to make the most effective use of the high power machine tools used in this shop it has been neces-

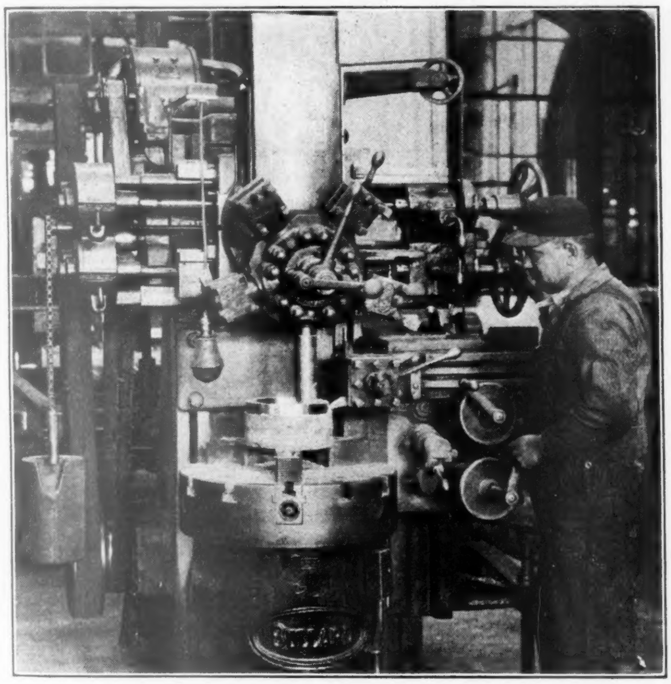


Floor plan of Burlington rod and valve motion shop at Aurora, Ill. The location of the machinery is indicated as well as the path followed by the rods through the shop from the time they are received from the blacksmith shop in the rough until delivered to the stores department finished

sary to pay special attention to the holding fixtures and methods of clamping the rods. These holding fixtures, some of which are illustrated, are featured by their rugged design, ease of adjustment and ingenious arrangement to hold different types of rods.

The question of milling cutter feeds and speeds is also highly important. While heavier feeds and speeds than those employed at the Aurora rod shop could probably be used, it is found that the actual cutting time is a fairly small proportion of the total time required for manufacturing rods so that it does not pay to use too heavy cutting feeds and speeds which will cause cutter trouble. More time can be saved by giving proper attention to methods of handling the rods and arranging for quick set-up and adjustment on the machine. The feeds and speeds mentioned later in this article are set about as high as permissible without causing excessive cutter wear and frequent grinding. About 12 cuts per grinding are secured.

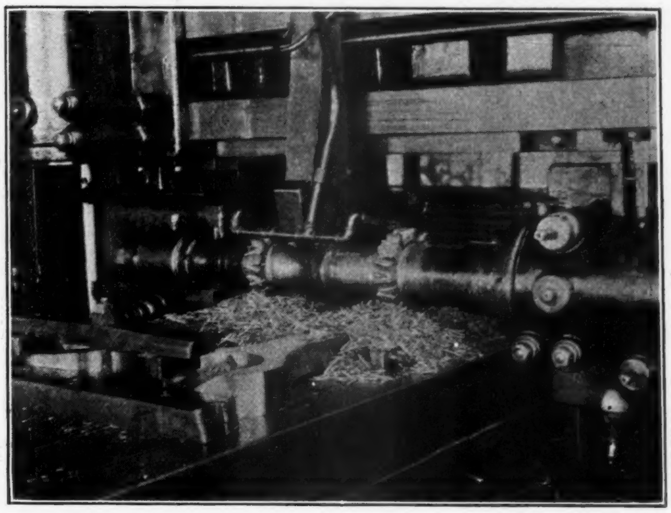
About 40 per cent of the Burlington rods are made of Nikrome steel. The 48-in. and 36-in. slab millers, driven by 75-hp. and 25-hp. motors respectively, are run at 45 ft. per minute on carbon steel rods and 35 ft. per minute



All rod bushings are machined on this 24-in. Bullard vertical turret lathe equipped with universal three-jaw holding chuck —The provision of the five-head turret and the side head to hold cutting tools, in conjunction with the convenient location of operating levers and hand wheels makes this a high production tool

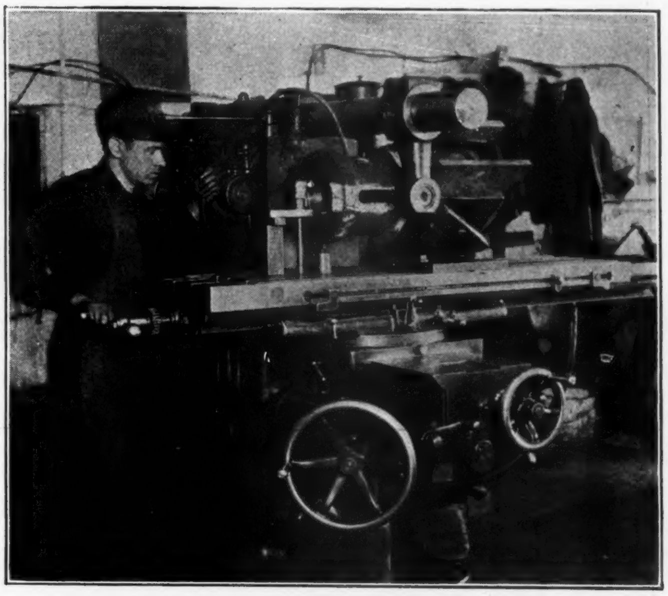
on Nikrome rods. The 48-in. machine is equipped with one 10-in. by 48-in. peg tooth milling cutter and one Goddard & Goddard inserted tooth slab milling cutter. The table feed, varying with the depth of cut, ranges from 3 in. to 8 in. per min. The rods are channelled with Helgren staggered-tooth solid milling cutters, ranging in width from 1¾ in. to 3½ in. The entire cut is milled in one operation, from ¾ in. to 1¾ in. deep, with a table feed varying from 2 in. to 3½ in. per min. Two rods are channelled at one time. These cutters are also interchangeable on the 36-in. by 36-in. slab millers.

The 54-in. Ingersoll vertical milling machine is equipped with 5-in. by 12-in. inserted tooth milling cutters and various sizes of solid milling cutters from 1 in. to 3 in. in diameter by 10 in. long for machining the rods outside and inside on the butt ends. Only one cut is taken on each end, no finishing cuts being required. Cuts on the ends of rods are taken to a depth of 2½ in., a 5-in. by 12-in. cutter being used which will permit milling two rods at a time. When cutting up to the full 12-in. length of the



Close-up view of 36-in. by 36-in. by 12-ft. Ingersoll slab miller machining the flutes in a pair of side rods

cutter it has proved advisable to reduce the feeds about 40 per cent. A feature of this machine, as shown in one of the illustrations, is the special holding fixtures which have an important bearing on the output secured. In view of the heavy cuts taken it is necessary to have unusually rugged holding fixtures and the factor of easy adjustment



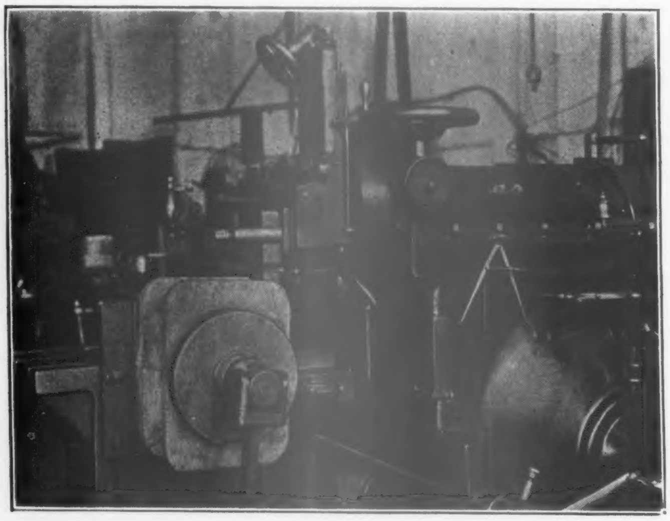
The No. 4 Brown & Sharpe universal miller is here shown machining a 1⅜-in. by 4¾-in. crosshead keyway—This machine also saves time in milling main rod keyways

to save time in setting up the work is also an important advantage. This machine, provided with a compound table with power operation in all directions, is especially built for rod work.

The heavy-duty Baker drills are also especially designed for rod work, having ample power and being equipped with push button control for starting, stopping and revers-

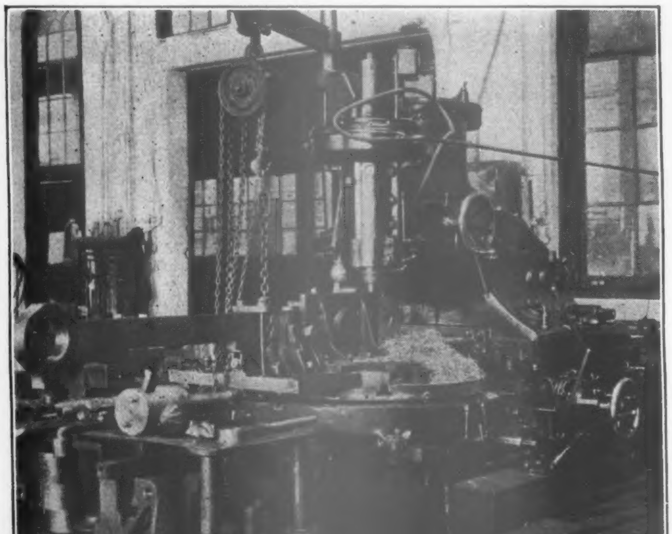
ing. All large side rod holes are cut by a three-cutter trepanning tool.

The 72-in. Sellers slotter, with power rapid traverse of the carriages and table and an ingenious method of obtaining exact speed control, is used for machining the insides of rod fork and front ends where the radius is so small that milling cutters cannot be used.



Main rod brasses are shaped accurately and with a considerable saving in time over older methods on this 28-in. Cincinnati shaper equipped with a Helgren indexing four-position chuck

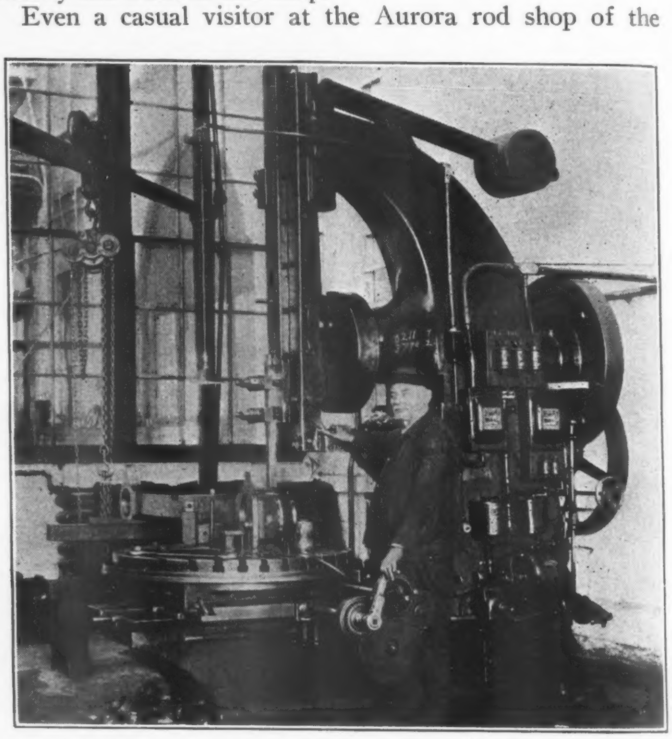
Main rod keyways are milled on the No. 4 Brown & Sharpe universal milling machine, crossheads and piston rods also being handled on this machine. Main rod keyways 1 in. by 16 in. are milled in approximately one hour. Crosshead keyways, 1⅜ in. by 4¾ in. are drilled and milled complete in 1¼ hr. Piston rod keyways 1⅜ in. by 4¾ in. are milled in 45 min. This machine is said to do the same work in one-third the time required on a $12,000 machine.



View indicating rugged character of the holding fixtures, which are also arranged for easy adjustments—The self-contained jib crane and chain hoist saves waiting for the traveling crane

The 24-in. Bullard vertical turret lathe is used for rod bushings and general rod and valve motion work. The Cincinnati 28-in. crank shaper, fitted with a Helgren rapid squaring and centering chuck, is used mostly for planing back end main rod brasses. A great deal of time is saved by this chuck and more accurate work is performed, enabling the brasses to be fitted on the machine to the exact size required for the rods. The time required for planing a back end main rod brass complete, fitted to the strap or the fork end of the main rod, is one hour. An additional 28-in. heavy-duty crank shaper will replace the 12-in. traveling head shaper shown in the drawing. The 75-ton rod bushing press is of Burlington make driven by a three-horsepower direct-connected motor. It is of the single plunger type with a quick return and handles readily the work in this shop.

Even a casual visitor at the Aurora rod shop of the Chicago, Burlington & Quincy can hardly fail to be impressed with the fact that this is a real production shop in which the production methods and machinery employed are on a par with those used in the best industrial shops in the country. The Aurora rod shop is conclusive evidence that the Burlington, like other progressive railroads, appreciates the importance of production methods in reducing the cost of repair shop operations and is applying these methods in cases where the volume of work involved is sufficient to justify them.



Fillets of too small a radius to be milled are machined on this 72-in. Sellers slotter—Easy power operation of the machine table in all directions is provided—The jib crane facilitates handling rods

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THE LOCOMOTIVE repair shops of the Pennsylvania at Sunbury, Pa., were closed on April 30. The lack of facilities for repairing large locomotives has necessitated the assignment of this work to other shops. Of the 200 men who are thus thrown out of work, many have already been given positions at other places. G. A. Schneider, master mechanic, retains his headquarters at Sunbury. Mr. Schneider is also master mechanic of the Schuylkill division. The first shop at Sunbury was built in 1865, and employed about 50 men.

A logical policy of locomotive maintenance*

Results of a study of economic factors determining the correct program of shopping cycles

By L. K. Sillcox

General superintendent of motive power, Chicago, Milwaukee & St. Paul, Chicago.

THE successful manufacturer must know the units of cost to produce his wares, for upon their application depends his profits. The universal adoption of more or less detailed cost accounts in both large and small establishments and the greater scrutiny given to them by owners and managers is real evidence of the value of such knowledge and the necessity therefor. Knowing that such information is successfully determined and applied in the commercial world, surely it can be as effectively established and employed in the matter of railroad locomotive maintenance and be the basis of executive policy with a view toward assisting the average motive power man in carrying out evident possibilities for economy and an eeffctive procedure at least cost.

Mechanical department economies are of two kinds: Internal economies which can be carried out independently by the mechanical officer of his own motion, and the much greater economies which management, as a whole, can only make possible, based on current studies as to policies and possibilities. Railroads are only typical of the more modern business organizations, and should seriously study, regardless of known obstacles, what the possibilities really are, and then constantly endeavor, item by item, to make progress along fundamental lines, all of which, for the purpose of our discussion, revolves around the question of the proper utilization of motive power. No one man, and indeed no combination of men, can evolve a best method off-hand from the foundation. It can only grow gradually, developing here and changing there, in line with economy, as the territory requires, or the nature of the traffic and competition in attracting the same becomes an issue. But the guiding idea of management having a proper and stable policy remains, nevertheless.

The expenditure for locomotive maintenance so far as it is caused by frictional wear and tear evidently will increase in direct proportion to the strain of the work done by the locomotive, and to the extent it represents outlay for replacement of parts, obsolete though not worn out, so far it is independent of the work done. Any plan used in the shopping of power involves complete considerations as to necessary maintenance and the effect from characteristics of service, as well as details of motive power construction, age and availability of shop, roundhouse facilities, etc. In not a few instances, much of the expenditure for locomotive maintenance, as reflected in the accounts, is occasioned from patching up old construction, even though in some cases this extends to the point where the actual repair cost, as renewed, exceeds the major portion of the value of the unit as renewed and, consequently, is recapitalized.

A close study will often indicate the folly of spending large sums per unit to continue obsolete designs in service for long periods when the same amount would be more than sufficient, as an initial cash payment, for an up-to-date efficient design of greater capacity and less cost to operate or maintain. Let us test by imagining a concrete case. Assume that a passenger engine 15 years old and originally designed to handle a nine-car train now is required to carry fifteen cars on the same schedule, resulting in a heavy maintenance cost due to frame breakages, racking of machinery, valve motion, running gear, etc., then it becomes a question not only of maintenance, but investment. If the original unit was of 40,000-lb. tractive force and was costing an average of $9,000 per year to maintain with a relatively low record of 3,000 miles per month, then it would seem proper to consider a new type of power, say with 50,000 lb. tractive force, which would afford 5,000 miles of service per month and yet not cost more than $5,000 per year for maintenance, making a saving of approximately $4,000 per year in maintenance cost and increasing the performance 66 per cent. This would justify making a change in power even though the original unit may have cost only $30,000 and the new unit $60,000. The original unit involved a maintenance cost of $9,000 per year plus a depreciation charge of $750 or a total of $9,750 as compared with an estimated maintenance cost of $5,000 per year for the new unit plus $1,500 depreciation charges or a total of $6,500, making a saving in the new unit of $3,250 per year, saying nothing of additional savings in fuel and transportation expenses. At 6 per cent this recovery would represent an investment of $54,000 or almost to the cost of the new unit, but if this were done on a large scale, then the amount of work would be performed with 66 per cent of the number of new units as compared with the number of old units and thus the change would be justified.

Two policies of shopping

There are many elements in the matter of executive policy which go to make a relatively high or low maintenance cost of locomotives, and the method of shopping power is one of the primary features to be considered. Two extremes of practice are found with many variations between them: One is what may be termed the high-frequency-shopping and the other the low-frequency-shopping policy. The former is that based on running locomotives through shops with an anticipated service of from 12 to 14 months with a minimum of roundhouse attention. The latter is that based on running locomotives through shops with the idea of having a service of 24 months or more and with a greater degree of roundhouse attention to attain this length of service. Vital elements in determining such a policy are the relation of the number and size of locomotives owned to the business handled, the road conditions for hauling heavy or light

*Abstract of a paper presented at the spring meeting of the American Society of Mechanical Engineers, held at Milwaukee, Wis., May 18-21.

tonnage trains, the topography of the country traversed, the distribution of industrial centers, the presence of large terminals, the spacing and capacity of roundhouses, the distribution and assignment of power, the placement of forces as between roundhouses and back shops, the rapidity with which mileage is run out and particularly the roundhouse and back shop facilities for handling certain classes of work. Furthermore, where a railroad has back shops of an obsolete character, it is practically as well off doing their work in roundhouses and it may be found helpful, under such conditions, to construct small modern back shop facilities at critical points to care for division requirements without increase in overhead expense.

The results obtaining under the two extremes of

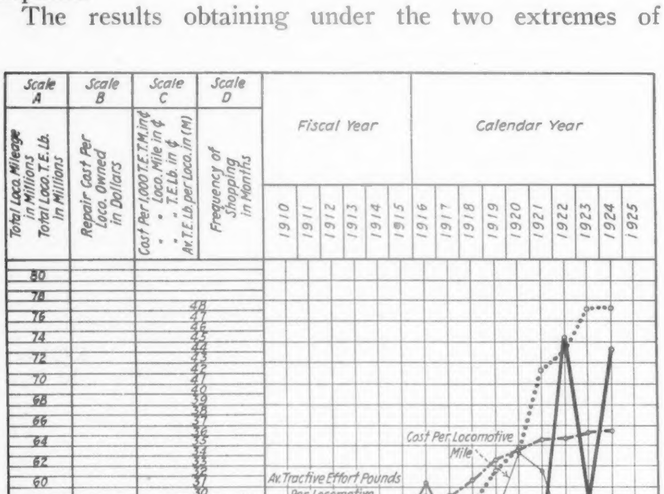


Fig. 1—Graphical illustration showing results of changing from a high to a low frequency shopping program on the C. M. & St. P.

policy mentioned have been observed for a considerable period and it appears that policy is largely governed by local conditions rather than local conditions being governed by the policy. The C. M. & St. P. has had experience under both plans, and just as a case in point, the general results obtained will be stated. Prior to 1921 a high frequency of back shop repairs was employed but after considerable study the plan was changed to a low frequency of repairs. The trend of unit costs, etc., both prior and subsequent to 1921, is illustrated in Fig. 1. This is a graphic illustration of the results obtained under these two extremes of policy, affected, of course, by the price trend of labor and material in the meantime. The lines plotted represent three general groups, one indicating the growth and size of units maintained, another representing the various unit costs of maintenance and a third representing the frequency of back shop repairs. The growth of property maintained is represented by the dotted line *A*, indicating the total tractive effort pounds owned from 1910 by years to the end of 1924. This growth was not all in the nature of new equipment, but represents power added by the acquisition of subsidiary and leased lines, as well as some new equipment, and to that extent the growth line should not be confused with the rate at which new equipment might have eliminated obsolescence. This very fact has a marked bearing on the cost of maintenance as the total growth consisted of approximately as many of the smaller and older locomotives as the acquisition of the larger and newer types. As to whether or not this extension of property was consistent with the growth of business naturally depends upon how the acquired lines may have increased the amount of business in relation to the amount of property. It is not desired to elaborate here upon the principles of the proper rate of growth of property, but merely to state that the method of computing the proper growth would be to determine the gross revenues per locomotive owned, affected somewhat by the characteristics of the lines added, as to their ability to function on a high or low unit train tonnage basis. Nevertheless, the growth of property represents a serious problem in the matter of having back shop development keep pace therewith and of getting continuous use from power.

Fig. 1 also shows (by heavy dot-and-dash line *C*) the increase in the average size of locomotive expressed by the mean tractive effort pounds per locomotive owned. The size of locomotives is an element in the unit cost of maintenance and it will be noted that this figure increased from approximately 24,000 tractive effort pounds per unit to 36,000 pounds in 1924 or approximately 50 per cent. The chart is confined to steam locomotives only, electric locomotives being a separate and distinct problem. It is not possible to state whether the growth in locomotive ownership increased more or less than the revenues or the average train load as this data is not available from the subsidiary and leased lines.

The feature in Fig. 1 deserving of closest study is the line *D*, representing the frequency of back shop repairs. This is arrived at by dividing the total yearly classified repair output into the total owned throughout the year, which expresses the number of years between shoppings thus developed and this, of course, varies from year to year according to the difference in the number of locomotives owned or used and the output. This is based upon a classification of repairs instituted during federal control and is translated back to 1912. It may be generally conceded that this classification is not sufficiently specific to be a complete measure of output, since the divisions are not based on work units to a great enough degree to permit of judging shop output in detail.

Results of low frequency shopping policy

The variation in the trend of line *D* is entirely dependent upon the allotment of labor and materials available for maintaining equipment. The shopping frequency increased gradually from 1912 to 1920, and during the latter year locomotives were going through at the rate of once every 14.28 months. In 1921 a committee was appointed to report upon the economics of shopping power, as a result of which it will be noted there was a radical change in the frequency of back shop classes of repairs subsequent thereto. This study related particularly to the situation existing on the Chicago, Milwaukee & St. Paul and is not offered as a criterion, for the reason that other conditions often determine whether or not such a policy is applicable to any but a specific case. The frequency of shopping trend, expressed both in years and in months between shoppings, was as follows:

Year	Years between shopping	Months between shopping
1920	1.19	14.28
1921	2.20	26.40
1922	3.30	39.60
1923	2.50	30.00
1924	3.70	44.40

The change in plan necessarily brought about some modification in the distribution of machine tools and facilities in back shops and roundhouses. Great care had to be employed to avoid deferred maintenance under such a transition, because of the great cost incident to overcoming deferred maintenance promptly and adequately, were this condition to have obtained. The roundhouses were partially equipped to do the necessary machinery and running repair work and in some cases rather heavy boiler work, so as to properly maintain the power for longer periods, some of the facilities being transferred from the back shops to the roundhouses. The back shop forces were reduced in proportion.

Prior to the change all judgment as to months good for, miles to be run between shoppings, etc., was based on the theory that locomotives were good for a term of 12 months only and, consequently, much data was prepared to show that this attitude was not in keeping with the operation of the property and, therefore, should be adjusted to the new method. Prior to 1921 there was no specific application of the plan of assigned mileage to be used as a basis for shopping power. This method was put into use at that time and a statement prepared showing the expected mileage to be run out after each classified repair, divided according to types of power. It is important that the same mileage should not be applied to the same type of power regardless of where or how used and in this respect an assigned mileage for each class of service, type of power and for each division instead of for the system as a whole is necessary in practice, otherwise classified repairs will be made in roundhouses, but not so reported in order to avoid breaking the mileage.

As to the results obtained from this change of plan, it should be understood that there were some wage and material price variations since 1920, but these adjustments account for approximately 14 per cent of the reductions attained. The cost trends on the chart merely indicate the actual reductions with no separation between fluctuations in the cost of material and labor, shop efficiency, etc. The cost per locomotive mile (line *C*) during the high wage period of 1920 had reached 34 cents, when the shopping frequency was 14.28 months, and since the frequency of back shopping was reduced the cost has steadily declined and in 1924 was less than 26 cents. This represents a reduction of approximately 24 per cent. The cost per tractive effort pound was reduced from 27 cents in 1920 to 16.5 cents in 1924 or 39 per cent. The cost of repairs per locomotive owned was $9,300 in 1920 and $6,000 in 1924, or a reduction of 35 per cent. The cost per thousand tractive effort ton miles was reduced from 1.075 cents in 1920 to .676 cents in 1924 or 37 per cent. In the meantime, the average size of locomotives increased 6 per cent. The method of measuring the cost of repairs per tractive force ton-mile was to take the tractive force pounds owned, reduce them to tons, multiply by the total locomotive miles run in thousands and divide this into the cost of repairs, Account 308.

This principle of shopping locomotives is in no sense special or peculiar. As to whether or not a policy as outlined could be taken as a criterion, it would be difficult to state. The plan was adopted for the C. M. & St. P. because it appeared to be properly applicable. It is a matter of interest, however, to make a study of ten carriers, where there is a wide range of policy, using the same units outlined above. The value of the units used cannot be considered as entirely intrinsic and for that reason the method employed should not be considered as absolute. Fig. 2 is offered as a result of a study of various carriers, some having a high frequency and some a low frequency method. In plotting the data, scales were used merely to throw relative items together in order to indicate those which run in a certain ratio and those which run inversely. The horizontal scale is the average tractive force pounds per locomotive owned to show the size maintained. The data is based on 12 months in 1924.

How size of power affects performance and unit costs

In the matter of performance the average miles per locomotive run per year is shown in line *A*, Fig. 2, and this indicates a difference in performance which does not follow relatively the variation in size of power, indicating many degrees in intensity of use, etc. The mileage

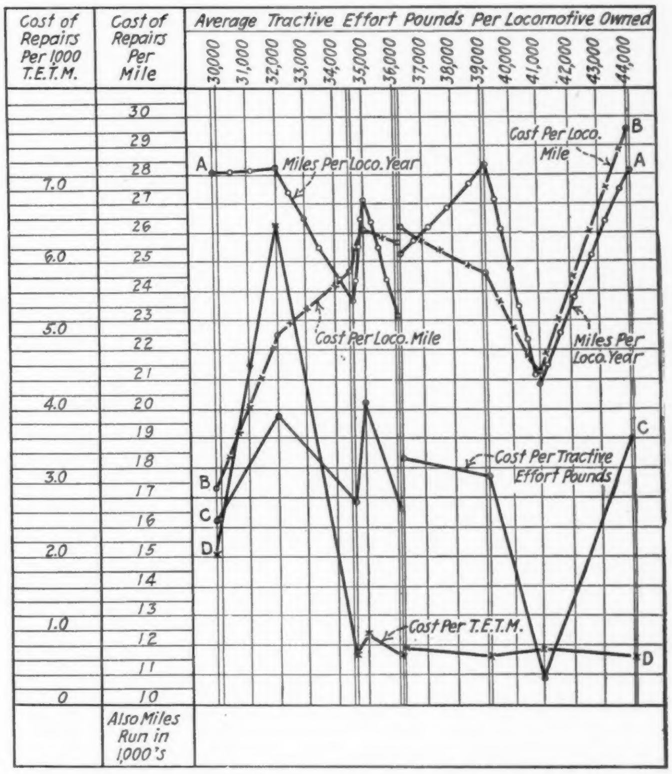


Fig. 2—Comparison of cost of maintaining steam locomotives considering average size, average miles, cost of repairs per mile per tractive force pound, and per 1,000 tractive force ton-miles

ranges from 20,800 to 28,476 per locomotive per year. The carrier with the largest size of power made practically the same mileage per locomotive as the one with the smallest size of power shown on the chart, whereas those administrations with locomotives of a size ranging between the two extremes made less mileage per locomotive. This may be considered an element of performance and demand characteristics of the lines involved. In this case the highest mileage was 37 per cent greater than the lowest shown.

The cost per locomotive miles as shown by line *B* is low for the carrier having the smallest size of power, being less than 17.5 cents and is high for the one having the larger size of power, the upper range being a little less than 30 cents per locomotive mile. The average size of power expressed in tractive force pounds was 47 per cent greater in the largest average size as compared with the smallest average size, whereas, the cost per mile was 71 per cent greater for the larger than the smaller power so that it may be said that in this case the cost increased one and one-half times as the unit size of power in-

creased. This figure itself cannot be considered as entirely significant.

The cost of repairs per tractive force pound does not run in direct ratio with the increase in size. It will be noted that while the smallest size of power has the lowest cost of repairs, the largest size of power does not have the highest cost of repairs, both being exceeded by carriers having locomotives of intermediate capacities. The composite factor of cost of repairs per thousand tractive force ton miles, followed somewhat inversely with the capacity of power owned, with variations in the intermediate sizes. Here it is interesting to note that the smaller size of power cost more than the large power, the result being due, in this case, to the carrier with the larger power running about the same mileage per unit as the carrier with smaller power.

In general, it has been found that carriers using large size of power have a fairly high frequency of back shopping, which is of great interest in this study because it is evidence, for the most part, of intensive use and a more or less uniform power demand. Thus far the frequency has been stated in terms of time only. It is affected very largely by the rapidity with which mileage is run out and, therefore, in a general way, reflects whether carriers are long or short in their power ownership.

This data indicates that as the average tractive force pounds owned increases, the cost of repairs per mile increases in a rather definite way; that the average miles per locomotive run and the average cost of repairs per tractive force pound have the same range characteristics; and that the average cost of repairs per thousand tractive force ton miles varies somewhat inversely with the average tractive force pounds per unit owned, with intermediate fluctuations.

Limitations of the units used

In using tractive force ton miles as a unit of measure, in this case, it should be understood that there is a variable feature in the actual amount of capacity employed as compared with the maximum available. Maximum or ruling gradients, scheduled tonnage, etc., are factors in determining how near the available capacity is utilized as compared with the maximum at hand and the studies shown here are made only with the intention of indicating that, regardless of any units of measure used, there are local conditions which determine the differences in the showing made. This unit of measure does not include the work performed—that is, the tonnage hauled—which if added would doubtless give trends differing from those shown on the chart. The tonnage hauled is a matter of record in freight performance only, whereas the data thus far considered applies to all classes of power.

Statistics are now available to show the gross ton miles per freight train hour, which is a fair measure of locomotive performance when considering the average size as well as the number of units employed. This reflects efficiency in train handling as well as corresponding utilization of power and where there is prompt turning in roundhouse care and running repairs fewer locomotives may be used for a given traffic and thus build up a reserve and maintain a proper shopping period. It is necessary, of course, to apply such data to road engines only and this can be done with the information at hand. The variation among carriers in such performance is quite extreme, some having as high as 26,000 and others as low as 12,000 gross ton miles per train hour. This difference is far greater than the average size of power and other influencing factors, such as grades, curvatures, signal stops, etc. This leaves open to study the question of greater development along the line of utilization of power and consequent shopping methods.

Relation between running and classified repairs is significant

Just what effect the specific policy followed has on the trend of the cost of repairs is not thoroughly ascertainable, but it would seem that a minimum cost may be expected when it has been definitely established that a proper balance between classified and running repairs has been arrived at. No specific formula for reaching this division has yet been developed. A study of the cost of repairs per mile divided between running and classified work does not present a solution, because whenever it is necessary to decrease or increase forces and expenses, the fluctuation is felt directly in the back shop and only indirectly in the roundhouse. There is no argument against the great need of having uniform forces and avoiding the closing of shops, because excessive fluctuations in forces cause repair programs and the continuity of work to be disrupted, besides it destroys discipline. Shop output is, generally speaking, directly affected by fluctuations and expenses and this seriously affects the frequency of classified repairs.

Our experience has developed the fact that the application of the assigned mileage for each type of power, regardless of its use, is not sufficiently specific and such process, when employed, needs revising by developing an assigned mileage for each type of power and for each division, so that the local characteristics as to track, curvature, gradients, service, consequent tire and lateral wear, and boiler repairs, can be considered as factors. Theoretically, it is possible to group repairs into time cycles, but time is only one of the elements of shopping power. As the frictional wear is mostly overcome in roundhouses the time element for shopping power resolves itself very largely into cycles based on necessity for heavy boiler repairs.

Factors used in fixing assigned mileage

The factors used on the St. Paul in the general plan of shopping are assigned mileage, time, and actual physical condition based on frequent inspections. Where there is a low rate of run-out mileage, time enters into the calculation to a greater degree than where mileage is run out rapidly. It can be arranged to set a limit of expenditures for the various types of power according to the class of repairs to be given, any over-expenditure to be reported and explained, so that extraordinary repairs may be a matter of record.

The regulation of frequency of repairs to locomotive parts is a matter of long range study and the cycling of repairs cannot be followed specifically in all cases, although it has been our general policy to endeavor to follow a Class 3 repair with a Class 4 or Class 5, then another Class 4 or Class 5 and then a Class 3; in other words, having two minor repairs between two major repairs. This depends on the nature of service performed and the severity as well as the rapidity with which mileage is run out. It cannot at the outset be presumed that we can obtain approximately 50 per cent of the mileage between classified repairs for the first Class 3 repairs and then 25 per cent for each of the minor repairs, as experience has developed that tire and lateral wear develop and become due for renewal just as soon after a Class 3 as after a Class 4 or 5 repair. It is well to contemplate a distribution of the mileage making it equal for each class of repairs, but regulate the cost of each shopping accordingly.

A study of shop and roundhouse facilities cannot be

summarized in terms of specific units, so as to outline the direct effect upon policy and the results thereof. It involves the number of roundhouses per mile of track, the frequency of turning locomotives or the miles run between turnings, etc. As a matter of interest, during the time the St. Paul was undergoing the change in policy referred to, we also made studies of engine house operation, not only as to repairs made, but as to the cost of turning power, frequency of turning, etc., with results shown below:

Transportation expense not maintained

	1922	1923	1924
Average turnings per month	53,572	59,784	54,911
Average cost per month	$430,492	$384,969	$331,830
Average cost per engine turned	8.30	6.44	6.04
Average cost per engine mile	10.25 cents	8.35 cents	7.68 cents
Average miles run between turnings	78	77	78

No comparison can be made with other carriers in this respect, because it is found that the methods of counting engines turned, the accuracy of distributing charges, the nature of roundhouse facilities, etc., vary too greatly. The above is merely shown to indicate that the trend in other expenses affected by locomotives was downward the same way as indicated in Fig. 1. It is very apparent that the frequency of turning power decreases with the increase in average distance between roundhouses, and that the average miles per engine turned will increase with the spread in distance between roundhouses.

We have not been able to observe any adverse effects on the turning of engines because of decrease in frequency of back shop repairs. It might have been assumed that so low a frequency as was developed in the change of policy would throw too much of a burden upon roundhouses for intermediate repairs and increase the hours of detention.

The formulation of specific policy of back shop attention to power, therefore, must consider a wide scope of performance, embracing amount of property owned in relation to the demand and use thereof, the type and size of power, shop and roundhouse facilities and their relation to each other, road conditions, rapidity with which mileage is run out and restored, the ability to maintain a minimum but uniform force in back shops throughout the entire year, the ability in addition to increase the rate of repairs in the low peak loading months so as to have a larger supply available for service in high peak months, the range of variation between high and low peak months, etc. Where back shop and roundhouse facilities are modernized by means of machine tools, power plants, handling devices such as cranes, hoists, tractors, manufacturing devices and an adequate store stock, it should be possible to determine closely the final balance between classified and running repairs with its relation to the cost of performance expressed in various units of measure, some of which were outlined above.

Effect of more intensive power utilization

The utilization of power requires careful and detailed study because any variation must, of necessity, have a marked bearing upon shopping policy. In cases where the per cent of power in service is low compared with the total owned it is usually found that the hours of service per day are low or approximately six, then it is possible to have a large waiting list and to turn locomotives less rapidly through the shops and still have ample protection.

A campaign to reduce the number of units in active service to a minimum consistent with traffic handled, based on the average miles per locomotive dispatched or the average miles between locomotive turnings (engine-house operation) will necessarily avoid the purchase of new equipment for the purpose of increasing the complement because when longer runs are installed and fewer locomotives are used for a given service this naturally builds up a surplus. Intensive service requires a revision of the method of repairs and in some cases calls for a higher standard of repairs than where more locomotives are used in the same service. The objective should be to get more locomotive miles per month out of fewer active locomotives and to get more hours of service per day out of each locomotive, then other factors will naturally increase the gross ton miles per train hour.

Modern tools and facilities save locomotive hours

Where orders are issued to shops for locomotives of a certain character to be made ready for service on short notice, the time factor, as regulating the date of delivery, is often a matter of supreme importance. A study of this question soon brings to light an intricate problem with which supervisors and others in authority have to grapple. One of the outstanding factors is that of the machine tool and material handling equipment, with which is identified the means of producing work rapidly and to the best advantage. Many of the latest machine tools, cranes, tractors, etc., are conspicuous for the facility with which they can be operated, the controls being conveniently placed, thus saving time in setting up and subsequently handling the machine.

Another equally vital point is that of the organization of the work, which must, if time is to be saved, be planned on a definite and progressive system. All these measures are applicable to old as well as the most modern new shops, however, they are likely to lose much of their value unless the workmen themselves co-operate in the avoidance of time wastage. It is only by strict co-operation of everyone concerned, combined with proper shop systems and the use of tools and facilities fully adapted to their purpose will rapid production be assured.

Need of a comprehensive program for future improvement

One point of serious practical importance remains, namely, that the designated mechanical officer should place before his executive a practical and sound analysis of the requirements for the upkeep of motive power, shops, power plants, tool equipment and recommendations for expansion or rehabilitation to reduce existing unit expenses known to be out of keeping with the possibilities for best achievement. In making submissions for proposed expenditures, they may be grouped under items of savings as dealing with: (1) fuel, (2) labor, (3) materials, (4) delay to train movements, and (5) accident or personal injury prevention.

It is regrettable and not a little surprising that in fixing ordinary running expense and upkeep, the budget allowance to be approved by any administration should fail to be based upon the requirements of traffic or operating conditions, complying with a general policy formulated to properly care for conditions in the most effective and economical manner and not altered to fluctuate with current temporary drops in traffic, which are often seasonal. What should be arrived at is a reasonable maintenance standard for the property as a whole. The basis should be gaged from a consideration of the general earning capacity and also upon the kind and class of traffic handled. With this part correctly fixed, slight fluctuations in business should not materially alter the progress with the view toward stability of employment and proper discipline and administration of the work.

The motive power man is only as successful as his

management will let him be. This is one of the reasons why so many able men have left the railroad service for other more productive fields. Every motive power man of wide experience knows what the lack of executive support means, and is also aware of what the hearty support of the management as a whole means toward a comprehensive and successful operation. The best policy on earth avails little if it does not have the support from the top of the organization down to the lowest man of the rank and file.

The foreman and his responsibility

First prize article in the competition recently held by the Railway Mechanical Engineer

By "Bill Brown"

A NUMBER of years ago, while working in a railway shop, I became a member of the city band. It was practicing nightly as it had entered as a contestant in a band tournament to be held shortly in a neighboring city. Practically every one in the small city was interested in having our band win. Several of its members worked in various departments of the shop, although I happened to be the only one in my department. One of the foremen, in conversation with the one to whom I reported, happened to mention that quite a number of the shopmen would be off work on the following Wednesday because of the band going away.

"Well," said my foreman, "none of mine will go!"

"But you have Bill Brown over there," said the other foreman. "He is playing a clarinet and will most likely go."

I saw them talking together but had not the slightest idea what it was about. Suddenly I realized that my boss was rushing over to my machine. Almost out of breath he commenced: "I hear you are going off with the band next Wednesday."

I replied: "Those who are to go have not yet been announced. Only 25 can be entered and we have 30 members."

But before I could get that far, he was waving his finger in my face saying: "Let me tell you young man, if you had gone without first asking my permission, you would never have got back here again."

"Why, Mr. ———, I had no intention of ———"

"That's enough! I want no back talk," said he and walked away. (He sure was making use of his opportunities.)

Later, in another railway shop, I started working for 19 cents an hour as a lathe hand and was promised an increase if my work proved satisfactory. Some months later—the day after pay day—I noticed my foreman paying more attention to my work than usual, going by and looking at me quite frequently. I began to wonder if something was up. He even spoke to me about the form of tool I was using, which I thought quite nice of him, since it gave me an opportunity to air my ideas on lathe tools. Then suddenly he asked if I had found anything the matter with my pay check the day before. I innocently remarked: "Nothing more than usual, for my wife has found some difficulty in making it cover our expenses." Then he opened up and called me the most ungrateful man who had ever worked for him, because he had got me an increase of half a cent an hour and I was not man enough to acknowledge it. Well the truth was that with the broken time we were working, I had not noticed the extra 40 cents and only got in worse trying to explain matters.

He certainly was attempting to fulfill his responsibilities all right. With these two examples before me, I remember making a resolution that if ever I became a foreman, I would never be like either of them.

The new foreman

To be more concrete let us consider the opportunities and responsibilities of a machine shop foreman who has just been appointed. At first, he may find himself under something of a handicap, whether he has been brought in from an outside point and placed among strangers, or promoted to be a foreman of men with whom he has been working for years. In either case he may naturally have to contend with a certain amount of what I may call quite reasonable envy, not necessarily malicious. There is bound to be one or more among those not chosen who could reasonably expect to have been promoted instead.

I would suggest, therefore, that when he is promoted he call his men together and say something like this: "Now, fellows, without any influence being used or any extraordinary efforts on my part, I have been given this position. I expect to make a success of it, but must have your hearty co-operation. Whatever opinions we may have formed of each other in the past are buried. We are starting off with a clean sheet. I do not want any one of you to be more square with me than I am with you. I want our relationship to be one of mutual helpfulness and pleasure, consistent with making it the success expected of us by our company. I shall want things done my way because I will be held responsible, but you will find me ready at all times to discuss your way and adopt it if you can show that it is the better way. Because I am the foreman, it does not follow that I know more about everything in this department than you men and the one making a good suggestion will be given the fullest credit."

Having thus started his career, our foreman should ask himself at the end of each day just how far he has fallen short of his responsibilities and opportunities as outlined for himself at the start; also if any of his men have failed in theirs. He can be as severe with himself as he pleases, as it is his own affair, but how will he handle those of his men who he is sure are not giving their best efforts? They must be studied individually. What could be said to one with good results, would fail utterly with another. Of course, I am assuming that the foreman wishes to keep his men and get them working with him and not to make use of his authority to let them go. That should be done only as a last resort.

Keep posted about railway affairs

He should try to acquaint himself with his men's point of view of things in general; and be ever ready to explain,

if asked, such workings of railway management as he is capable of, why short hours are sometimes necessary, the operating ratios, fuel saving, taxation, rates, etc. To become fairly well posted on these subjects, it is not necessary to devote more than one-half hour each evening to the columns of *Railway Mechanical Engineer* and the Railway Age. In fact, to keep in touch with the latest railway shop practices and the workings of the other important departments, it is essential that he be at least a casual reader of these journals. The more he studies them, the more he will realize what his responsibilities and opportunities really are. The advertising columns alone are an education.

Treatment of new employees

The new man you take on is just as anxious to make good as you are to have him. The foreman's responsibilities and opportunities in this respect are very pronounced. If the new man is taken to his machine, given a job and a blue print and told to get busy, he may possibly succeed in giving a good account of himself. If, on the other hand, he is told, in a friendly manner, a few things about the shop, its methods, number of men employed, just how to obtain tools from the tool room, who to ask for information he may need, and that he is not expected to make a record the first day but to accustom himself to his surroundings first, and then go ahead, it will make a great difference. If you happened to notice when you hired him that he wore a fraternal pin, if he is an entire stranger it might be well to say to Bill Jones (if Bill also wears a similar pin on his best clothes): "Say, Bill, you might take a little interest in that fellow for a few days. He is a stranger in the shop. I believe he will make good as he has been well recommended and we will give him every chance."

Of course the foreman should first be reasonably sure that the man has the ability required. It is not necessary to hold every man who starts, but the greater number who are held, the less the labor turnover and consequently the greater ultimate shop efficiency.

New tools or machinery

The foreman should at all times be familiar with the prices and types of various tools that could be installed to advantage in his shop or department. He should be ever ready, on a few hours' notice, to state definitely just how five, ten or fifty thousand dollars could be economically expended on machinery or devices for improving the production of his department. A close study of the advertising pages of the previously mentioned journals, a few days spent in visiting shops where such machines are in service, or the writing of a few letters to other foremen, are all productive of a wonderful amount of valuable information to be kept ready at hand for just such a time as this. It is most inexcusable for a foreman not to keep himself thoroughly posted on the latest products of the machinery builders which can be profitably installed in his department.

The sales engineer

There are certain shops where the foremen are not permitted to meet any of the sales engineers. Those who are privileged to meet such representatives and discuss new machine tools with them are certainly losing opportunities in making unsound excuses for not doing so. These men as a class are far from being ordinary peddlers. They generally have an interesting story to tell and the writer has often been obliged (gladly) to work extra hours because of having spent some of his time during the day investigating the claims and merits of various machines or devices with which he was unacquainted; and has felt amply repaid for so doing.

The foreman's relationship to the foremen of other departments should be the same as that of each member of a successful baseball team to the others—team work at all times. He should not be delighted to see the other fellow get into a hole but be more than ready to assist him to keep out of one. The opportunities for this display of inter-department team work are so numerous they can not be listed. I am calling attention to them because there is an altogether insufficient amount of this sort of team play noticeable in many railway shops.

Conservation of material

A great deal has been written about the wonderful work of the reclamation departments, but foremen should realize that before a great deal of this material can be reclaimed or salvaged, it must first pass through his department as scrap. He must see that nothing goes out in the scrap to the reclamation department which is merely sorted out and returned to him to be used again.

Among the most important of his responsibilities should be the systematic gathering and indexing of many useful facts in connection with his department, such as the comparative value and cost of leather and fabricated belting, cost of such standard articles of daily use as monkey wrenches, hammers, taps, hack saws, nuts and bolts, oil for machinery (who is using the most of these things and why), the comparative cost of electric and acetylene welding and cutting processes and the amount saved weekly by their use. These are but a very few of the large number of very ordinary everyday facts foremen are frequently found to be unacquainted with. Lack of space alone prevents one from dwelling at greater length upon such an important subject.

Attitude toward apprentices

Perhaps his greatest responsibility is in his relationship to the apprentice boys under his charge. These boys come to him fresh from the school teacher. Possibly he is the first man they have ever worked for and, at first, perhaps they should be looked upon as one does upon a frisky colt when first being broken to harness. Much of the boy's future success in life depends upon how the foreman handles him during this important formative period of his career.

Even if there is an apprentice instructor devoting his entire time to the boys, or if the boy is turned over to the charge of a gang boss, take time occasionally to stop and ask him how he is getting along, and how he likes his work. Endeavor to start him thinking by asking such questions as will make him investigate things for himself, such as why do you think we superheat locomotives, why do they apply boosters to engines, is the air pump operated by superheated or saturated steam, how do they get water into a boiler, and hundreds of other and varied questions, always having one ready to ask him. Note the pleased smile when your boy at last gives you an accurate reply. Then congratulate him. A pat on the shoulder and a few words of encouragement from his boss from time to time are never forgotten and cost you nothing. Remember too, these boys are always pleased to get your mechanical journals when you are through with them. Mark an especially interesting article occasionally and pass it around among the boys; then discuss it with them later. You will hear some interesting comments.

One of the most pleasant of many experiences with boys was that of recently being surrounded by about twenty bright apprentices and listening to each one try to explain to me the reading of a 24-inch Brown & Sharpe vernier. They had been asked the week before if they could do so and upon replying they could not, were given a week to try to find out. Many went to the public library for in-

formative articles. Others looked up tool catalogues. Altogether it proved to be a very interesting talk and helped impress one with the responsibilities and opportunities of a foreman in this respect.

I cannot close without making some reference to the responsibilities and opportunities in being thoroughly systematic in so routing the work through the shop as to be able at all times to determine what caused a delay to a pre-arranged schedule of production. To be able to say justly: "Thou art the man," is a most important opportunity and until the foreman is able to do exactly that, even if the "man" is himself, he is not living up to his responsibilities.

Many other aspects of the question could be presented at some length, including the responsibilities in connection with those directly superior to him, his opportunities for boosting the worthy men under him and seeing that they are given proper recognition, his relationship to the stores department, his connection with and support of such work as safety first and first aid, and his interest in shop sports, baseball, football and even horseshoe pitching, etc. These are his responsibilities and opportunities.

Santa Fe apprentice instructors meet

The three-day conference at San Bernardino proved to be more than ordinarily successful

THERE are many features which contribute to the splendid results the Santa Fe derives from its system of apprenticeship training. Once each year the apprentice instructors of the system, some three-score-and-ten in number, are assembled under the leadership of F. W. Thomas, supervisor of apprentices, for a three-day convention in which to discuss methods and practices relative to the training and development of apprentices. Besides talking shop with each other and discussing matters directly bearing on the work of the apprentice department, they also have the benefit of the advice and council of many mechanical department officials who attend these conventions and take active part in the deliberations. The instructors also have the opportunity of listening to addresses from system staff officers on subjects relating to their respective departments and to discuss in an informal way with these officials matters in which they are directly interested.

It has been the custom to hold these conventions on a different grand division of the system each year, thus giving the instructors an opportunity to become more familiar with the road as a whole and to observe the equipment and learn of the methods and practices used in different shops. The conventions for the three preceding years were held in turn at Topeka, Kans., Galveston, Tex., and Albuquerque, N. Mex. This year's convention was held at San Bernardino, Calif., April 23-24. Last year the instructors had an opportunity to visit the company's new up-to-date shops at Albuquerque and this year to see the new shops now being erected at San Bernardino.

In order not to take up space desired by the traveling public in regular sleepers, the instructors enroute to and from the convention were carried in two special sleepers, thus giving them an opportunity of mingling with one another, of talking shop, comparing and discussing in an informal way methods and practices in which they are jointly interested. It was interesting to note how the car department instructors, or the boiler maker instructors, or some other group would get together in the Pullman smoker or elsewhere and talk over their special problems. Many of the instructors reported fully as much real help from these informal discussions while enroute to and from the place of meeting and between sessions of the convention as from the convention itself.

This year's convention was reported to be the best ever held, more interest and enthusiasm being shown than ever before. Four supervisors of apprentices of other roads, all former Santa Fe apprentice instructors or graduates, were present and took part in the discussions. H. S. Wall, mechanical superintendent, A. G. Armstrong, superintendent, San Bernardino shops, and all master mechanics of the Coast Lines attended each session, taking an active part in the meeting. Other Coast Line officials and many foremen from the local shops attended certain sessions. The following staff officers addressed the convention: George Austin, general boiler inspector, T. S. Stevens, signal engineer, E. J. McKernan, supervisor of tools, Roy Hunt, fuel supervisor, L. H. Collett, safety supervisor, and E. E. Chapman, engineer of tests. The instructors were welcomed to San Bernardino by the mayor of the city and by the president and the secretary of the Chamber of Commerce, who besides boasting of their city, as only Californians can do, stated that the railway was the backbone of their city, and that the city's welfare was closely linked with and dependent upon the welfare of the railway.

Mr. Wall in his opening address said that two prominent mechanical officials of other roads had told him that when a Santa Fe apprentice graduate asked for work, they always made a place for him; they knew he would be a skilled all-around mechanic. It was an evidence of the thoroughness of the training given apprentices on the Santa Fe that other roads not only come to study the methods used but that several of them had employed apprentice instructors from the Santa Fe to install and conduct apprenticeship systems on their roads. He pointed with pride to the list of 240 apprentice graduates who are now filling official positions on the road, seven of them being division master mechanics. He urged the instructors to renew their efforts to leave nothing undone that would make the apprentices better mechanics and better citizens.

The following outline of a few of the subjects discussed will be of interest and reflect the thoroughness of the methods used by the Santa Fe in the training of apprentices.

Boiler maker apprentices

The discussion relative to boiler maker apprentices embraced three features of boiler maker apprenticeship—Federal rules, autogenous welding, and the Locomotive Folio. Each boiler maker apprentice is provided with a copy of the company and Federal rules on maintenance of boilers and appurtenances thereto and is required to study these rules. At stated periods in the school course he is required to answer in writing certain questions. He

first roughs out the answers on a scratch pad, then submits them to the shop instructor who ascertains if he has a clear understanding of the rules covered. The apprentice then, as a part of his school course, neatly prints out the answers. The shop instructor also quizzes him while he is actively engaged in boiler work in the shop to see that he knows and understands the rules pertaining to the work on which he is engaged.

The discussion as to welding covered the amount of welding experience to be given each boiler maker apprentice, the use of the welding folio, the value of requiring the apprentices to make test welds and thereby prove their ability to do good welding, and how to provide sufficient experience for apprentices at points where opportunities are limited.

The Locomotive Folio is a book of standard practices for the system. The apprentices are made familiar with and taught to obey its instructions. The rules in the folio are taught in much the same manner as the Federal rules. At the close of the discussion of the subjects pertaining to boiler maker apprentices and after the address by George Austin, general boiler inspector, the boiler maker apprentice instructors went into conference with Mr. Austin, and discussed various features of boilers and boiler work.

Car department apprentices

Considerable time of the convention was devoted to the discussion of carmen apprentices, the schedules of shop work assigned carman apprentices, the portion of time to be devoted to steel and to body work, the relative value of the different classes of work in the coach shop and cabinet shop, the importance of all freight carman apprentices having a thorough knowledge of A. R. A. Rules, and methods of teaching these rules. It was the general opinion that the carman apprentices now in service were doing exceptionally well and that as they were graduated the road would be supplied with carmen of much greater than the average ability and training. C. N. Swanson, formerly superintendent of the Topeka car shops, was present and took part in the discussions.

School room schedules

Schedules have been adopted showing the time allotted for each series of lessons assigned the apprentices in the school room. These schedules have been effective in increasing the amount of school work completed. Each apprentice is advised of his standing and at most places the record of all apprentices is posted on a bulletin in the school room, thus creating a friendly rivalry and inspiring each to maximum effort. Moreover the supervisor of apprentices is given a monthly report showing how much each apprentice is ahead or behind the prescribed schedule. Some instructors were asked to tell why so many of their apprentices were behind the schedule, others why their apprentices easily made the schedule. In this way many valuable suggestions were received, and conditions pointed out that will be corrected.

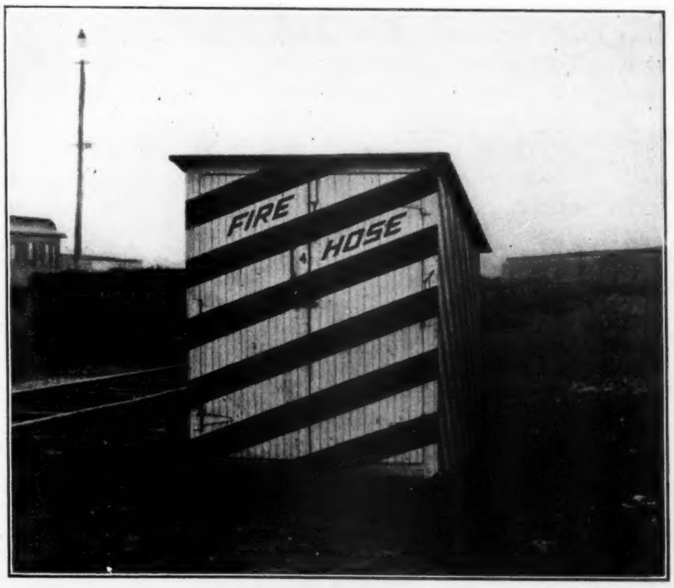
Apprentice clubs

During the past two years, apprentice clubs have been organized at practically all division points on the system. Two system apprentice conventions have been held, one at Albuquerque a year ago and one at San Bernardino the past year. These and the conferences of railroad boys conducted by the R. R. Y. M. C. A. at St. Louis and Detroit have created great interest and enthusiasm among the apprentices and have proved of much help in the development of the apprentice clubs. Through these clubs the morale of the boys has been raised. They are taking greater interest in their work and in the affairs of the community. The purpose of the clubs is to give the apprentices an opportunity for clean sport, a social good time, an opportunity to lead and direct meetings, to bring apprentices and officials and shopmen closer to each other, and to create a greater loyalty toward each other and to the road they serve.

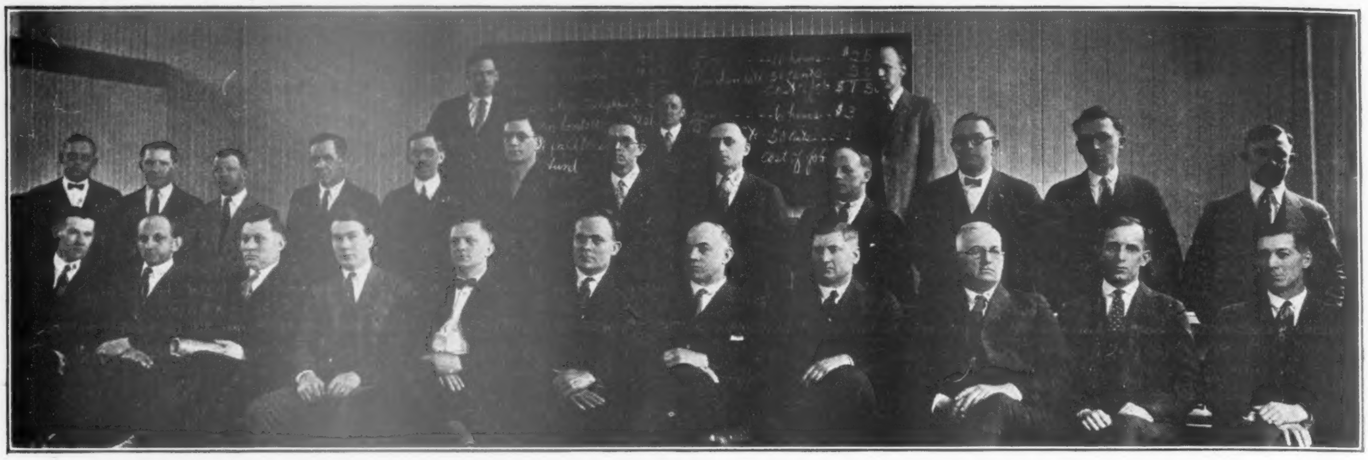
The instructors in reporting the activities of their respective apprentice clubs vied with each other in telling of the good things accomplished. Some clubs had devoted most of their activities to athletics, others had had debates and lectures, others dances and other forms of entertainment, several had put on theatrical events, one club had pulled off a real wild west rodeo, had contributed generously to the rebuilding of a church that had been burned, also to a community hospital, and through a paper of its own had carried on a successful campaign against shipping by truck. From the reports of the activities of the various clubs, the instructors received ideas which will enable them to assist their clubs in making even greater progress during the coming year. It was agreed by all that these clubs and these system apprentice conventions and the national conferences of young men were productive of much good and should receive the hearty support of all who are concerned with the training and development of young men.

There was an exhibit of shop kinks, each instructor having been asked to bring to the convention at least one jig or labor saving device, or a model, print, or photograph of it, gotten up by him or used in his shop, which he thought could be used to advantage at other shops. These proved interesting and helpful.

The addresses by staff officials were most instructive. T. S. Stevens spoke on automatic train control, Roy Hunt told how the shop man could aid in fuel conservation, L. H. Collett, talked on safety, E. J. McKernan talked on tools and shop machinery, congratulating the instructors on their assistance during the past year and showing where further reductions could be made in the expense chargeable to tool account. E. E. Chapman told of the work of the test department and of assistance the instructors could render. All-in-all the convention was a most instructive and inspiring one.



Effective method of marking fire hose stations at the North Billerica shops of the Boston & Maine



Members of the Lehigh Valley foremen's training class at the enginehouse and annex, Seneca Division, Sayre, Pa.

Training foremen in leadership

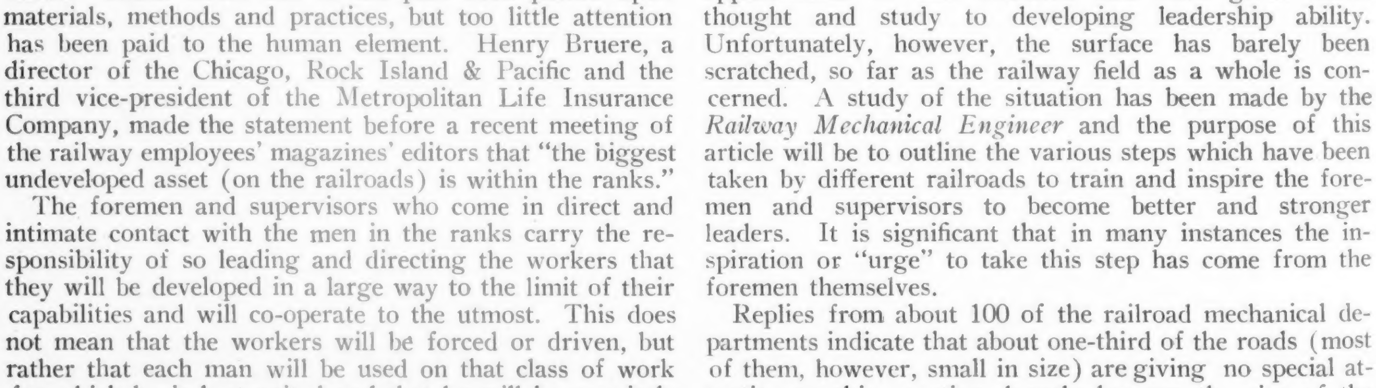
This movement, which started in a small way a few years ago, is now going forward rapidly

THERE has been no more striking development in industry and transportation in recent years than the growing recognition of the importance of leadership ability on the part of the foremen and supervisors. Much stress has in the past been placed upon materials, methods and practices, but too little attention has been paid to the human element. Henry Bruere, a director of the Chicago, Rock Island & Pacific and the third vice-president of the Metropolitan Life Insurance Company, made the statement before a recent meeting of the railway employees' magazines' editors that "the biggest undeveloped asset (on the railroads) is within the ranks."

The foremen and supervisors who come in direct and intimate contact with the men in the ranks carry the responsibility of so leading and directing the workers that they will be developed in a large way to the limit of their capabilities and will co-operate to the utmost. This does not mean that the workers will be forced or driven, but rather that each man will be used on that class of work for which he is best suited and that he will be so wisely directed and helped that he will find a real satisfaction in his work and will utilize his peculiar talents in the most effective way to the mutual advantage of himself and his employer.

Many foremen have recognized their responsibility and opportunities in this direction and have given much thought and study to developing leadership ability. Unfortunately, however, the surface has barely been scratched, so far as the railway field as a whole is concerned. A study of the situation has been made by the *Railway Mechanical Engineer* and the purpose of this article will be to outline the various steps which have been taken by different railroads to train and inspire the foremen and supervisors to become better and stronger leaders. It is significant that in many instances the inspiration or "urge" to take this step has come from the foremen themselves.

Replies from about 100 of the railroad mechanical departments indicate that about one-third of the roads (most of them, however, small in size) are giving no special attention to this question, largely because the size of the organizations is such that the head of the department



Lehigh Valley foremen's training class at the Sayre, Pa., enginehouse and annex in session

can keep in intimate touch with all of the foremen and supervisors under his direction. Of the other two-thirds of the roads, several have developed fairly ambitious plans for the training of foremen, although the greater proportion are confining their efforts in this direction to measures which are far from adequate.

Staff meetings

Staff meetings are quite commonly held, varying all the way from daily meetings at the larger shops for half an hour or so, directly after shop hours, to annual meetings in the nature of a convention. It is only fair to say, however, that in many cases these staff meetings deal almost exclusively with detail problems in connection with material and its handling, shop practices and co-ordination of departmental activities, rather than the problem which most concerns us in this article—a discussion and consideration of those things which will help the foreman to get a better understanding of human nature and of how to develop his leadership ability. It is significant, however, that there is a growing recognition of the importance of placing emphasis upon this question of leadership and that more and more attention is being given to it in the staff meetings.

Of the roads which indicate that they hold such meetings at shop or division points, three state that the meetings are held daily, lasting for a short period, ordinarily not exceeding one-half hour; 18 roads state that weekly staff meetings are held; 23 state that staff meetings are held, but the intervals are not specified. One road, the Chicago, Milwaukee & St. Paul, also holds annual staff meetings, the programs for such meetings being carefully worked up and papers prepared in advance, much as is done by a progressive railroad association.

One road has found that splendid results have followed the holding of weekly staff meetings of the foreman with the group of men who work with him. This provides an opportunity for the foreman to talk to the men as a group and to conduct an open forum discussion, thus promoting better understandings. It was said to be quite evident from observation of these meetings that the foremen needed special training and coaching in the problem of dealing with the men and properly leading them.

Several roads hold bi-weekly or monthly meetings at the shops, at which representatives of the shop employees meet with the foremen to discuss shop conditions in general. Such conferences naturally develop better and more cordial understandings and relationships, as well as constructive suggestions of benefit to both the company and the employees.

Foremen's clubs

A variety of programs have been developed by what may be called foremen's clubs, or which in some cases are designated as mechanical supervisors' associations. Readers of the *Railway Mechanical Engineer* will recall the article on "A Comprehensive Plan for Executives' Clubs", by Simeon van T. Jester in the issue of February, 1924, page 79. The foremen's clubs on the Pennsylvania Railroad were described in an address by I. U. Kershner at the meeting of the New York Railroad Club on May 18, 1923; an abstract of this address was published in the Railway Age of May 26, 1923, page 1259.

The clubs as they were first organized on the Pennsylvania Railroad and the Reading usually held seven or eight meetings during the season at intervals of about two weeks. About an hour was allotted for an address, after which the members separated into small discussion groups, spending another hour in open forum discussion, considering the application of the principles which were developed in the address to the specific departments or responsibilities of the men in the group. The successful handling of these group discussions made it necessary for the leaders to get together in advance of the meeting to talk over the points it would be desirable to develop for discussion. Some of the clubs have done away with the discussion period and are now scheduling only an address. The Reading clubs and the Harrisburg club on the Pennsylvania, however, continue to follow the original practice. The Harrisburg club publishes a bound volume each year, containing a report of the addresses and the findings or high points which were brought out in the different group discussions.

During the past year there were nine clubs in the Eastern Region of the Pennsylvania Railroad, including Altoona, Baltimore, Harrisburg, New York, Philadelphia, Renovo, Sunbury, Trenton and Wilmington. The members of these clubs pay annual dues. In most cases the high school is available for the meetings and there is little expense in connection with carrying on the work of the clubs, except for the cost of the speakers. The company shares the expense with the clubs. The end of the season for the Pennsylvania clubs was characterized by a joint meeting of the Baltimore, New York, Philadelphia, Trenton and Wilmington clubs at the Bellevue-Stratford Hotel, Philadelphia, on March 11, an address being made by Samuel M. Vauclain, president of the Baldwin Locomotive Works. A similar get-together meeting of the Altoona, Harrisburg, Renovo and Sunbury clubs was held in the Chestnut Street Auditorium at Harrisburg, Pa., on March 21, Roy V. Wright, editor of the *Railway Mechanical Engineer,* making the address.

The Pennsylvania clubs include in their membership foremen and supervisors from all departments. There is thus not the temptation to deal with detail shop methods and practices or details of operation. The subjects are naturally concerned with the larger problems of management in its various aspects. The program of the Pennsylvania clubs, for instance, included three addresses by Dr. A. F. Sheldon, one on "Principles of Service", another on "Psychology of Human Relations", and a third, "Universal Efficiency Formula". Doctor Sheldon characterized this group of lectures as a part of the science of human engineering, which he called the science and art of man-power development. The other addresses on the Pennsylvania clubs' programs differed more or less from each other. In addition to Doctor Sheldon's addresses at Harrisburg, Superintendent William Elmer made an address on "Maintenance Versus Renewals"; E. E. Griest on "The Foreman as a Business Getter"; Superintendent of Motive Power E. B. DeVilbiss, "Legislation Affecting Railroad Operation"; and John A. Oartel on "The Foreman and Safety First". In contrast to this the Altoona club, in addition to the three addresses by Doctor Sheldon, had one by Dr. A. B. Van Ormer on "Co-operation Among Railroad Employees"; one by W. D. Henderson on "Human Nature and the Changing Order"; and one by Charles Woodward on "Supervision from the Human Standpoint".

Reading Company clubs

Three foremen's clubs open to supervisors from all departments were organized on the Reading in May and June, 1923. The Philadelphia club has a membership of about 430, Reading about 395, and Shamokin about 150. The arrangement of the programs has already been referred to. During the first year the clubs held ten educational meetings and a banquet. During the past season they have held eight educational meetings, one outing and two banquets.

Boston & Maine clubs

Last year four foremen's associations were organized

in the mechanical department on the Boston & Maine. Monthly meetings were held by the members of these clubs on their own time and expense, for the purpose of discussing questions of supervision and efficient shop practice. The railroad management co-operates to the extent of furnishing speakers and, where necessary, meeting places. These four associations or clubs functioned so greatly to the satisfaction of the members that four additional clubs were formed during the past year, making eight in all. The location of the clubs with the membership is shown in the following table. These clubs have held an average of six meetings each during the past season.

Concord Car and Locomotive Foremen's Assn.	65
Billerica and Terminal Junction Locomotive Foremen's Assn.	90
Billerica and Terminal Junction Car Foremen's Assn.	90
East Fitchburg and W. N. & P. Car and Loco. Foremen's Assn.	75
East Deerfield Car and Locomotive Foremen's Assn.	60
Mechanicville-Troy-Rotterdam Car and Loco. Foremen's Assn.	45
Lyndonville-White Mountain Car and Locomotive Foremen's Assn.	50
Springfield Car and Locomotive Foremen's Assn.	30
	505

The tendency, since these clubs are made up entirely of mechanical department foremen and supervisors, has been to go more into the details of mechanical department operations, although the importance of developing a higher quality of leadership has not been entirely lost sight of. Moreover, it is only fair to say that the discussion of the detail mechanical problems has been a large factor in bringing about better understandings between the different foremen and departments and in helping to standardize the best practices. One of the most productive programs during the season was a discussion of the changes in the 1925 American Railway Association Rules of Interchange. There is no question but what the educational material which was developed by this discussion has been responsible for a very considerable financial saving for the Boston & Maine.

Undoubtedly the work of these clubs will be featured in the future by more consideration of questions affecting the directing and development of the human element in the organization. The clubs have formed an Association of Clubs and an attempt is being made to co-ordinate the programs so that the foremen over the entire system will have the benefit of the discussions and questions which arise at any one of the meetings. The Association of Clubs held a get-together dinner and entertainment at Boston on Saturday, May 9, at which brief addresses were made by several officers of the association, by President Hustis and other officers of the railroad, as well as by Prof. William J. Cunningham, James J. Hill Professor of Transportation at Harvard, and Roy V. Wright, editor of the *Railway Mechanical Engineer*.

Other foremen's clubs

The foremen and supervisors on a number of railroads are carrying on activities of a somewhat similar nature.

Central Railroad of New Jersey.—The foremen have recently organized a club at Elizabethport, N. J., taking in the Central division supervisors; and a club at Ashley, Pa., including the Lehigh and Susquehanna division supervisors.

Chicago, Burlington & Quincy.—Supervisor's clubs have been organized and meet regularly at all of the larger points. Foremen prepare papers for discussion on questions pertaining to the handling of men and improved shop practices. Addresses on the art of leadership and other questions of particular interest to the foremen are made by qualified leaders from other fields.

Delaware, Lackawanna & Western.—There is a supervisors' association on this road which holds meetings at least once a month. Officers are frequently asked to make addresses and a monthly leaflet, "The Lackawanna Supervisor", is published under its direction.

Duluth & Iron Range.—A supervisors' club is giving a good account of itself, its purpose being to elevate "the social, moral and intellectual standing of the supervisory force and to cultivate a general spirit of harmony."

Kansas City Southern.—The Mechanical Department Supervisors' Association has a northern division with headquarters at Pittsburg, Kans., and a southern division with headquarters at Shreveport, La. Each group meets once a month and the meetings are alternated in such a way that representatives from one group can find it possible, if their duties permit, to attend a meeting of the neighboring group. Two or three papers are discussed at each meeting. Frequently committees are appointed to follow up some of these subjects and present their findings at a later meeting.

Minneapolis & St. Louis.—A Supervisory Officers' Club has been organized at Marshalltown, Iowa. It holds regular monthly dinner meetings at which papers are presented and topics of interest discussed. It has been a large factor in promoting harmony and co-operation.

Nickel Plate.—A foreman's club is conducted in the local Y. M. C. A. at one of the shops. The programs include addresses on various topics relating to the foremen and their interests, and the railroad.

Northern Pacific.—The foremen at the large shop points have club meetings and other activities in connection with the International Association of Railroad Supervisors and Mechanics. In addition to this, bi-monthly meetings are regularly held at the large shop plants, alternating between safety meetings and staff officers' meetings. The shop crafts representatives attend the safety meetings. Both the staff officers' meetings and the safety meetings are attended by all of the supervisors in the locomotive and car department, as well as representatives from the stores department and the division accountant's office. Ordinarily two papers are presented, prepared by members of the group. This is followed by a general discussion. A report of the meeting, including the papers and the discussions, is furnished to each of the supervisors and copies are also sent to the general officers. It is believed that the preparation of the papers by the foremen and supervisors is helpful in broadening their point of view.

Union Pacific.—Monthly meetings are held by the Mechanical Supervisors' Association, in addition to the staff meetings which are held at the larger shops and division points.

Wabash.—There are supervisors' clubs at Moberly and Decatur, all foremen and supervisory officers in the mechanical and stores departments being eligible. Monthly meetings are held at which technical papers are presented and discussed. Entertainment features are introduced at these meetings and occasionally the meetings take the form of social functions or smokers, with the idea of getting the members and their families better acquainted and promoting a spirit of good fellowship.

Clubs which failed

It is only fair to say that all of the foremen's clubs that have been organized have not made good. We have learned of two such clubs which failed—apparently because they were organized on too ambitious a scale and did not grasp their possibilities in developing leadership ability. But let the brief account which we have received tell its own story:

"The purpose of their organizing was more of a social and educational nature than a railroad business proposition. At ———— the foremen fitted up club rooms which at first were very well patronized by them-

selves and friends. It was not long, however, until interest lagged and this together with the expense entailed soon caused the club room plan to be abandoned. Interest in the meetings they held, which were addressed by different gentlemen on different subjects, also soon diminished and it was not long until we heard no more of the club. No doubt one of the reasons for the loss of interest so soon was the fact that the foremen represented all departments and kinds of work—carpenter, blacksmith, boilermaker, machinist, etc.—and a subject that would be interesting to part of the men would be tiresome and like Greek to the others."

Foremanship classes on the Lehigh Valley

The Lehigh Valley has approached this question of foremanship training in a rather different way from the other roads, although similar practices have been followed in other industries in recent years with excellent results. The foremen enroll in a course on foremanship which has been developed and promoted by the Engineering Extension Division of Pennsylvania State College. The men pay $15 each for the course. The company has co-operated by seeing that adequate facilities are provided for carrying on the class work, and the officers, whenever they have been called upon, have taken a keen interest in participating in the program. Meetings of an hour-and-a-half duration are held once a week. At Sayre, Pa., the foremen at the enginehouse and on the Seneca division form one group and meet in a room adjacent to the enginehouse which has been fitted up for class work of this sort, as well as a social center where the foremen and men may gather at lunch time. This was the first group to form a class of this kind and it has completely covered the course laid out by State College; it is continuing to function as a class and is developing its own topics for study and discussion. A similar and somewhat larger group of foremen and supervisors from the system shops at Sayre hold their meetings in the apprentice school room. There is another group at Easton, Pa.

The first unit of the course is devoted to the responsibilities of the foremen. These are considered in a general way and include a discussion of the characteristics of a successful foreman. The second unit considers aids in production and includes a discussion of those things which have both a direct and indirect influence on production. The third unit discusses costs and their relation to the foreman. The fourth, the foreman's relation to employment; among other things it considers the selection and following up of the worker, a discussion of the cost of turnover, methods for reducing it, etc. The fifth unit is devoted largely to a consideration of safety and the foreman's relation to it. The units following this include other important phases of the problem of leadership and production and also a brief review of the history of industry.

The members of the class first read one of the study units. A member of the class or an officer or representative of State College may then give a talk, discussing the application of the principles from his point of view. This is followed by an open forum discussion, which frequently is carried over to include the class period of the following week. After the study unit has been thoroughly discussed the men answer certain questions in writing and send them to State College, where they are corrected and graded.

The Lehigh Valley people are enthusiastic over the results which have been obtained. The advantages of definitely organizing the study work are obvious. The thinking of the men is directed along a specified program, which has been found to meet the needs of the foremen and supervisors in industry generally. The important principles are discussed in logical sequence. It is true that the Pennsylvania State College course was not specially devised for railroad supervisors. It was developed and outlined after conferences with men from industrial organizations throughout the state and has been very carefully checked up in the industries. The principles of successful leadership are the same on the railroads as in the industries, but there would be certain advantages in considering these principles more particularly from the railroad mechanical department point of view. This would lead to the emphasis of certain parts of the course, while other parts would be given less attention.

The foremen at the system shops of the Lehigh Valley at Sayre, Pa., hold their classes in the apprentice school room

A pertinent suggestion

Unfortunately the programs of most of the foremen's clubs or supervisors' associations are made up of subjects or topics which are not as closely related or co-ordinated as they might be, or are not presented in a logical sequence. Too frequently also the programs are largely in-

spirational in character and no organized attempt is made to follow them up. Study classes have a considerable advantage from this point of view.

One superintendent of motive power who was greatly impressed by this feature and by the fact that more must be done to cultivate and develop real leadership ability, makes this suggestion: During certain times of the year the shop hours are reduced and in many cases the men do not report for work on Saturday. The foremen, however, are expected to report and to plan and discuss the work of the coming week. The suggestion is that the foremen hold a staff meeting at such times, giving whatever attention is needed to the routine problems, and then setting aside a definite part of the time for classes conducted along much the same lines as those on the Lehigh Valley. This suggestion would appear to have great possibilities and its working out will be watched with much interest.

On the Burlington

At one point on the Chicago, Burlington & Quincy a night school class for the supervisors is directed by a representative from a nearby college. The course of study includes plant operation, supervision and other matters of special interest to the foremen and supervisors.

Visits to other shops

Several roads have adopted the practice, when work is light, of having the foremen and supervisors visit other shops on their own system or on other roads. The result is said to have a broadening and inspiring effect on the foremen. Visits made to other shops on the same road help to bring about and promote standard practices, as well as better understandings. Visits to shops on other roads often develop new points of view and frequently result in changing or reorganizing the handling of the work.

When foremen are sent to make such visits it is sometimes well to indicate specifically that they are to look for those things in which their neighbors excel. Nothing is gained if the foreman comes back with nothing new, but with a lot of satisfaction in telling how he is doing things better than the foreman at the shop which he visited.

Technical magazines

Several mechanical department superintendents report that they either furnish the foremen or encourage them to take and study technical magazines. In some cases the foreman's attention is specifically directed to articles in the magazines, and he is asked to give in writing his opinion of the value of the practice or device which is described, and indicate whether it can be introduced in his department to advantage.

Papers such as the *Railway Mechanical Engineer* are clearing houses for the best methods and practices. The value of systematically reading and studying them is commented upon in the first prize article in the contest on the Opportunities and Responsibilities of the Foreman, which appears elsewhere in this issue.

Books

The number of books dealing with problems of leadership and management has been steadily increasing in recent years. These books cover all phases of the broad problem of management and personnel administration. It is surprising how little they are known or read by railroad foremen and officers. Two or three roads have furnished their foremen and supervisors with copies of "Spark Plugs" by Sherman Rogers. This is a small book, easily read and inspirational in character. Between it and "Personnel Administration" by Tead and Metcalf, there is a broad area. The latter book is a standard work on personnel administration, going into all phases of the question in detail.

Thus far but one book has appeared which is related definitely and entirely to the railroad field. That is "Personnel Management on the Railroads" prepared by the Policyholders' Service Bureau of the Metropolitan Life Insurance Company and published by the Simmons-Boardman Publishing Company. It has only recently been published. It does not go into the details or principles of leadership, but does outline what the progressive railroads are doing in different ways to improve the standard of efficiency of management and bring about better relations and teamwork.

R. E. Woodruff, superintendent of the Erie, in speaking at the May meeting of the New York Railroad Club, made this significant statement: "Our men do not know how to oil the human machines properly and, worse yet, they are not aware of it. A check of one organization developed that only 14 per cent of the officers of all grades had actually read or were reading anything that would help them improve their knowledge of human relations. Forty per cent read only technical magazines and papers; 46 per cent admitted that they read nothing but daily newspapers. Some of these men did not appreciate that they were standing still—each was ambitious for promotion but was not studying to qualify for advancement. * * * * Many of these men did not appreciate that there was anything to be gained from reading or studying. They did not know that there were any books on the question of salesmanship or of securing co-operation."

Bulletins

It is the practice on the Delaware, Lackawanna & Western to hold weekly meetings of all shop and enginehouse supervisors and also to issue semi-weekly bulletins to the supervisors. These contain comprehensive information about conditions and include discussions of such things as the human equation, the proper method of planning, costs, shop schedules, etc. These bulletins have been found to broaden the perspective of the supervisors and to give them a better idea of the railroad as a whole and the way in which the different departments can work together to the best advantage.

Study courses

Many of the roads encourage the foremen and more ambitious men to enroll in the correspondence schools or to take special study courses which may prove helpful to them. Several of these schools have courses on foremanship. The Railway Educational Bureau at Omaha has prepared a course of study particularly directed to the needs of the supervisors on the railroads; it was only recently completed, but has attracted favorable attention on several roads.

The course includes a study unit or instruction paper on personal considerations, which includes the following points: The responsibility placed upon the supervisor by his position and title, the desirable ends to be accomplished by the supervisor in carrying out his duties, the supervisor's attitude of mind toward his work, the supervisor's attitude of mind toward his men, the desirability of training one or more understudies, and the supervisor's duty to himself as regards preparation for his own further promotion.

Following this is a unit on the man problem. Attention is also given to the Americanization question in a unit entitled, "The Melting Pot," which is supplemented by a special unit which includes the Declaration of Independence and the Constitution of the United States. Then

follow units on methods of creating co-operative efficiency in railway work, the handling of the present forces, a series of studies on discipline covering the Brown system, the handling of minor offenses and the handling of major and dischargeable offenses. This is followed by a unit on the employment and handling of new men and two units on money values, including one on costs and values and the other on the budgeting of expenses. One unit which has been specially devised to inspire or stir up the student is entitled, "Seeing, Hearing, Thinking." Then come several instruction papers covering the general considerations for planning and scheduling work, on routing work, dispatching work, standards and standard practice instructions, and records. The series as now outlined closes with units on additional personal considerations, promotions and day-by-day supervision.

The Railway Educational Bureau does not require written tests, but the material is so arranged as to encourage the student to think and study along the right lines, the Bureau agreeing to answer any questions that he may ask for further help or information. A question which naturally suggests itself is as to whether a discussion group or class at a local point could not follow such a course to advantage.

Special instruction

One road has found it profitable to provide special instructors to visit the various points on the railroad and conduct schools or classes for supervisors in the mechanical department. Special attention is given to such matters as the federal locomotive inspection rules and the Interstate Commerce Commission safety appliance rules. This movement was started because of the large number of new foremen who were taken into the service in 1922. The returns upon the investment have been so large that this special educational work is being continued.

Apprentice training

At least one mechanical department superintendent insists that the training of foremen should begin when the boys start to serve their time as apprentices. The point that this officer wishes to make—and he is not connected with the Santa Fe—is that one of the best things that has been done in training foremen is the remarkable development of apprentice training on the Santa Fe, which has been so frequently commented upon in the Railway Mechanical Engineer.

An inquiry, inspired by this suggestion, brought forth the information that the Santa Fe apprentice department keeps an "Honor Roll" which contains the names of the young men who have completed their apprenticeship courses in the last 12 or 14 years and have been promoted to official positions. This honor roll shows that 240 apprentices have been promoted to the following positions:

Division master mechanics	7
Division and general foremen	23
Roundhouse foremen	16
Assistant roundhouse and gang foremen	63
Machine and erecting foremen	38
Boiler foremen	18
Car foremen	6
Miscellaneous foremen	7
Miscellaneous positions	16
Apprentice instructors	46
Total	240

Selecting men for promotion

Another mechanical department superintendent indicates that the responsibilities and requirements upon the foreman are so great that we must not only give greater attention to training and coaching them, but must in the future select as foremen, men who have had a reasonably high and broad education.

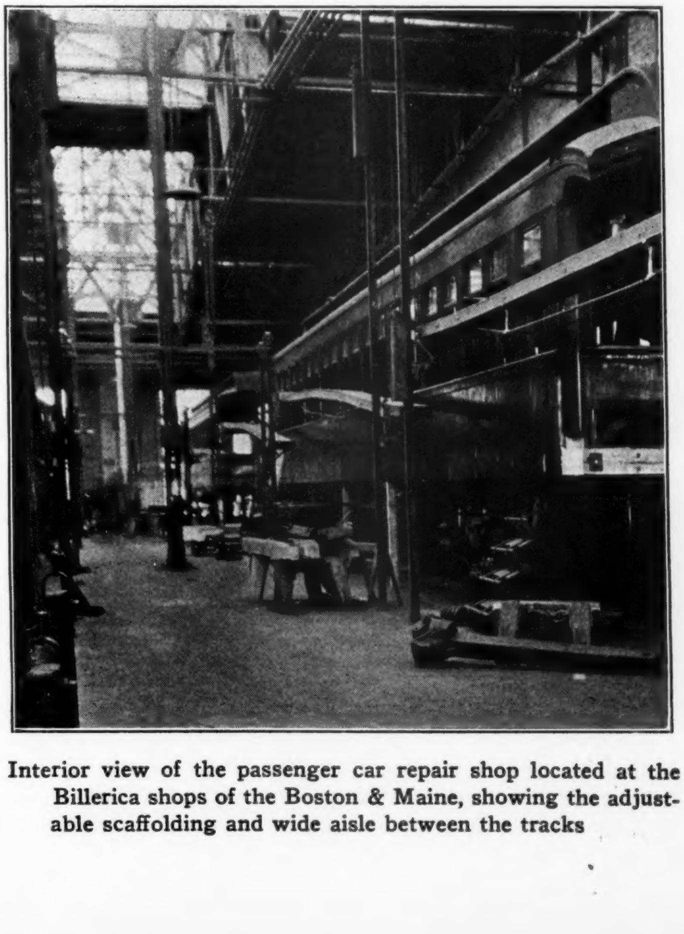
Other mechanical department superintendents place particular stress upon the importance of using the greatest possible care in selecting men for promotion and in seeing that they are carefully coached on dealing with the human element before they are actually placed in charge of a group of men.

General railway clubs

Some of our correspondents have drawn attention to the fact that the railroad clubs throughout the country have given more and more attention in recent years to this question of management and human relations on the railroads. A survey of the topics which have been discussed at the railroad club meetings indicates that one or two of the clubs have been giving an unusual amount of attention to these questions. Apparently this has been appreciated, for these particular clubs have been growing in strength and numbers and the consensus of opinion is that the members appreciate a reasonable amount of this sort of material.

Conclusions

This survey is not intended to be complete or thorough. It is based upon replies to a letter which were received from the greater percentage of the heads of the mechanical departments on the larger railroads of this country and Canada. This has been supplemented by observations by members of the staff of the *Railway Mechanical Engineer*. One thing, however, is clearly evident and that is, that there is a growing recognition of the importance of having the foremen and supervisors secure a better understanding of those principles upon which successful leadership must be based. There are several ways in which this problem can be approached and much progress has already been made on some roads in helping the foremen to improve themselves. The natural result of this has been a better understanding and an improvement of relations between the managements and the workers. It is one of the first steps that must be taken if we are to develop that degree of real teamwork and co-operation which is so much desired.



Interior view of the passenger car repair shop located at the Billerica shops of the Boston & Maine, showing the adjustable scaffolding and wide aisle between the tracks

Master Boiler Makers meet at Chicago

The sixteenth annual meeting of the Master Boiler Makers' Association proves to be one of the most successful in its history

THE sixteenth annual meeting of the Master Boiler Makers' Association opened Tuesday morning, May 19, at the Hotel Sherman, Chicago, with about 700 members, guests and supply men in attendance. President Frank Gray, was in the chair at the opening session.

After the invocation, H. T. Bentley, general superintendent of motive power, Chicago & North Western, addressed the meeting. During his talk he suggested that the name of the association might appropriately be changed to Railway Master Boiler Makers," without altering the by-laws or limiting the membership to the railroad field. Practically all members are railroad men and he felt the name should convey this thought.

His suggestions were of a practical nature and dealt with better maintenance, cleaner tubes, the prevention of front end air leaks, and steam leaks—all working for better fuel economy, performance and safety. He also touched on the all important apprenticeship problem. Some incentive must be given young men to enter the railroad trades including boiler making, he said. Foremen and all others should work with the boys and help them in every possible way. When an apprentice completes his course he should be able to handle any and every phase of his trade with facility. He will be able to do this only if his supervisors have worked with him.

The competition between motor truck, bus and railroads received comment. Mr. Bentley said that these vehicles, performing the duties of common carriers, should carry some of the burden of taxation, road maintenance and other items to which the railroads are subjected if they are to be allowed to compete with them. Without such an equalization of tax burden, the motor transport service receives what is in effect a public subsidy and cuts materially into railroad business.

Following Mr. Bentley's address the president delivered his annual address. The remainder of this session was devoted to reports of the secretary and the treasurer and to routine business. Letters were received from A. G. Pack, chief inspector of the Bureau of Locomotive Inspection, and A. R. Ayers, assistant general manager, New York, Chicago & St. Louis, expressing regret at their inability to be present at the convention.

The Wednesday session opened with an address by W. J. Tollerton, general superintendent of motive power, Chicago, Rock Island & Pacific. Economy in operation and maintenance was the keynote of Mr. Tollerton's talk. The executives of the railroads look to the motive power department for the accomplishment of economy in maintenance. To a great extent the members of this association can make savings possible in maintaining in good condition the boilers under their care. Mr. Tollerton also discussed the loss of revenue due to the competition of the motor bus and truck in handling passenger and freight traffic. Following the discussion on this point, he touched on the possibility of fuel saving through the application of thoroughly tested devices such as the thermic syphon, the feedwater heater, the superheater and other appliances. One other matter was emphasized in his talk—the absolute necessity for boiler shops being properly equipped with machine tools so that work may be handled economically and efficiently.


Frank Gray
President


T. F. Powers
1st Vice-President


H. D. Vought
Secretary


W. H. Laughridge
Treasurer

The report of the Recommended Practice and Standards Committee on the subject of "proposed boiler welding practice" was read and each section discussed and acted upon by the convention. As a result of the discussion, the report will be put in final form with such changes and additions as were found necessary to meet the approval of the body. The report in its final form will be acted upon at a later meeting.

The morning and afternoon sessions on Thursday were devoted to the discussion of special topics prepared by committees of the association. The following subjects were included: "Acetylene and electric welding of firebox sheets"; "Flue sheets in combustion chamber boilers"; "Repairing of cracked bridges and cracks in flange knuckles"; "Renewal of staybolts adjacent to those found broken"; "Method of applying arch tubes"; "The train-

ing and developing of boiler inspectors and assistant foremen boiler makers"; "The most reliable water level registering device on a locomotive boiler"; "What is the most economical pump station boiler"; "Boiler corrosion, pitting and grooving."

Officers elected for the coming year

The final session on Friday, May 22, was devoted to routine business. The following officers were elected for the coming year:

President, Thomas F. Powers, assistant general foreman, boiler department, Chicago & Northwestern; first vice-president, J. F. Raps, general boiler inspector, Illinois Central; second vice-president, W. J. Murphy, general foreman boiler maker, Pennsylvania; third vice-president, L. M. Stewart, general boiler inspector, Atlantic Coast Line; fourth vice-president, S. M. Carroll, general master boiler maker, Chesapeake & Ohio; fifth vice-president, George B. Usherwood, supervisor of boilers, New York Central; secretary, Harry D. Vought; treasurer, W. H. Laughridge, general foreman boiler maker, Hocking Valley; executive board, one year, E. J. Reardon, Locomotive Firebox Company; H. J. Raps, general boiler foreman, Illinois Central; L. E. Nicholas, general boiler foreman, Chicago, Indianapolis & Louisville; two years, C. H. Browning, foreman boiler maker, Grand Trunk; L. R. Porter, foreman boiler maker, Soo Line; A. F. Stiglemeier, general boiler shop foreman, New York Central; three years, I. W. Clark, general foreman boiler maker, Nashville, Chattanooga & St. Louis; F. T. Litz, general boiler foreman, Chicago, Milwaukee & St. Paul; C. J. Longacre, foreman boiler maker, Pennsylvania; A. F. Stiglmeier was elected chairman of the board and H. J. Raps, secretary.

Air Brake Association at Los Angeles

Power brake problems are discussed—Address by W. J. Patterson of the Bureau of Safety

The Air Brake Association held its thirty-second annual convention at the Hotel Alexandria, Los Angeles, Cal., May 26 to 29, inclusive. The association was welcomed by a representative of the city and on behalf of the railroads by W. K. Etter, general manager of the Atchison, Topeka & Santa Fe Coast Lines. Addresses were also made by President C. M. Kidd, air brake inspector of the Virginian, and W. J. Patterson, assistant director Bureau of Safety, Interstate Commerce Commission. Abstracts of these addresses follow:

President Kidd's address

The question was raised of the advisability of holding this convention at such a distant western point as Los Angeles, but our selection of this city is justified by the large attendance. Los Angeles was selected to follow our practice of taking the convention to the different parts of the country to accommodate not only the members of the association, but in order accommodate railroad employees in general.

The character of the Air Brake Association is different from that of any other railroad association. It is purely and wholly an educational institution. The more thoroughly air brake education is disseminated, the better will be the operation of freight and passenger trains and railroad transportation will be correspondingly benefited. Perhaps no separate division of railroad operation carries the same responsibility as the air brake. If one road does not follow recommended practice in the maintenance of triple valves, with standard triple valve test racks, codes of tests, properly adjusted piston travel and properly maintained retaining valves and pipes, and another road does this work, the air brakes will operate at a low efficiency. All must work together in harmony and co-ordination. This can be brought about only by proper education and that is what the Air Brake Association is striving for. It should have the moral and practical support of all railways and railway officers.

Undoubtedly the coming year will bring with it important developments in air brake work. Better conditioning of the equipment and the intricacies of automatic train control will call forth the fullest attention and best efforts of air brake men. We must be ready!

Address by W. J. Patterson of the Bureau of Safety

At the annual convention of this association in 1919, I presented a paper which set forth quite fully the requirements of law and orders of the Interstate Commerce Commission with respect to air brakes, as well as policies and practices of the Bureau of Safety in their administration. At that time I requested this association to co-operate with the government in bringing about general improvements in air brake conditions throughout the country. That is being done, yet still better observance of the rules governing maintenance and conditions of air brakes is necessary for the protection of employees and travelers on our railroads. At that time I said, "I am a very strong advocate of air brake tests on trains when arriving at terminals, and I believe that incoming air brake tests, together with prompt repair of air brake defects, will result in such great improvement in air brake maintenance conditions as to preclude the necessity for more stringent action on the part of the Bureau of Safety than a reasonable interpretation of existing law and the orders of the commission which are in effect at the present time."

What was true at that time is true now and in view of the increasing train length that I then advocated is even more necessary at the present time. Since the date of that meeting there have been several events of outstanding importance affecting the maintenance and use of power brakes. In February, 1922, the Interstate Commerce Commission began an investigation of power brakes and appliances for operating train brake systems, to determine whether and to what extent power brake equipment in common use was adequate and in accordance with the

requirements of safety, what improved devices were available, and what improvements should be made to provide increased safety. The condition of repair of air brake equipment which existed at that time is indicated by results of inspections made by the Bureau of Safety.

In the fiscal year ending June 30, 1922, approximately 1,100,000 cars and locomotives were inspected, on which a total of 55,427 safety appliance defects were found. Approximately half of all these defects, or 27,271, were defective air brakes. In that year inspectors of the Bureau of Safety also tested the brakes on 244 trains upon their arrival at terminals; these trains consisted of 8,898 cars, of which 9 per cent were cut out or had otherwise inoperative air brakes; on 294 cars the brakes were cut out and on 508 cars the brakes were inoperative from other causes.

The number of inoperative brakes in service was altogether too large, indicating a lack of proper attention.

In addition to this altogether too large percentage of defective air brake equipment, the necessity for this general investigation by the commission into the use and operation of power brakes was revealed by representations which were made by certain railroads that freight trains could not be controlled with a proper degree of safety on heavy grades by means of power brakes alone as required by the law. In this investigation, after considerable evidence had been taken and tests conducted, the commission issued a report dated July 18, 1924, and among other things stated that "Improvements in the operation of power brakes for both passenger and freight trains are essential and must be effected." They further stated that "Throughout this proceeding the necessity for better maintenance of present power brake equipment in order to secure proper operation and safely control trains was repeatedly stressed, and this necessity was recognized by both carriers and employees. It is beyond question of argument that piston travel should be maintained within proper limits, triple valves should be kept properly cleaned, brake pipe and brake cylinder leakage should be kept below certain prescribed amounts, and retaining valves with their pipe connections should be kept in good condition; furthermore, rules should provide and proper tests should be made to insure that trains will not leave terminals with defective, inoperative or cut out brakes on any cars."

During the commission's hearings it was noted that no witnesses either for the carriers, the brake manufacturers or the employees testified that power brake systems as a whole were maintained in an efficient or satisfactory oprating condition. On the contrary witness after witness testified that improved performance would result from better maintenance and that such better maintenance should be required.

Following the issuance of this report several conferences were held between representatives of the American Railway Association—who by the way were members of this association—and representatives of the Interstate Commerce Commission, which resulted in an agreement to adopt certain recommendations for maintenance as a measure for carrying into effect the requirements of the commission's report. These rules will be put into effect at an early date and I know that the members of this association will do their part to see that they are religiously observed. The result of their operation will be observed by the commission to determine their effectiveness. Should it be found that these rules, or rules issued in this manner, are not effective to secure the required improvement in air brake maintenance and operation it will become necessary to consider other means and adopt other methods to secure such improvement.

The revised rules establish minimum requirements to which brakes in service must conform, and set forth tests which will disclose whether or not equipment in service meets the prescribed requirements. Each carrier is, however, left free to determine the detail methods and means which it will employ to place and keep the air brake equipment used on its line in the condition required by the rules. Carriers are expected to issue necessary additional rules and instructions, provided, however, that such additions are not inconsistent with the rules which set forth minimum requirements applicable to all carriers.

Another event of great importance in connection with the maintenance and use of air brakes was a decision of the Supreme Court of the United States, handed down April 28, 1924, which construes the associated car provision of the air brake law. In the fiscal year, ending June 30, 1923, inspectors of the Bureau of Safety conducted terminal tests of the brakes on a total of 1,602 trains which were made up and ready for departure. These trains consisted of 50,254 cars, and on 7 per cent of these cars the brakes were cut out or inoperative. On 615 cars the brakes were cut out, and on 2,809 cars the brakes were inoperative from other causes. In the following year some improvement was indicated. A total of 1,504 trains consisting of 50,910 cars were tested; 3.3 per cent of these cars had cut out or inoperative brakes, 296 brakes being cut out and 1,408 being inoperative from other causes. It should be borne in mind that these tests were made after the trains had been made up and inspected by railroad company employees and the trains left the points where the inspections were made in the condition indicated.

In the case decided by the Supreme Court, cars with their brakes cut out were intermingled with operative brakes in the train and hauled from a point where repairs could be made. The court held that the failure of the power brake on a car did not take the car out of the power brake class; that the cars involved in this case were associated with other power brake cars, that the act specifically requires all power brake cars so associated shall have their brakes used and operated; and that cars on which the power brakes have been cut can lawfully be hauled only when placed to the rear of all cars having their power brakes operated by the engineer. For many years the Bureau of Safety has contended that all air brakes on each train should be operative leaving a terminal or other point where repairs could be made. This decision supports that view.

In a meeting of this association, it is entirely unnecessary for me to discuss the question of how to maintain brakes. The records of your previous annual meetings are full of descriptions of such work and suggestions as to what is required to be done. From the standpoint of the Bureau of Safety, in connection with the administration of the law, it is entirely immaterial what detailed methods are employed by the carriers to place and keep air brake equipment in condition to conform to federal requirements. Our only concern is that it shall be done, and that tests are made at sufficiently frequent intervals and repair facilities provided to insure that the air brakes on all cars in trains are in effective operating condition. The distance between points at which inspection, tests and repairs are to be made must be determined separately for each carrier according to their requirements and character of service. The Bureau of Safety will continue to make air brake tests, on both arriving and departing trains, at suitable points to determine the actual condition of brakes on trains operated on each line of railroad.

In improving air brake service on the American railroads, I want to assure you that you have the hearty cooperation and support of the Interstate Commerce Commission.

Big attendance at Fuel Association convention

Many operating and mechanical officers register— L. F. Loree makes the opening address

THE opening session of the seventeenth annual meeting of the International Railway Fuel Association, which was held at the Hotel Sherman, Chicago, May 26 to 29 inclusive, was characterized by an unusually large attendance in which many operating and mechanical officers and supervisors were included, as well as the officers of the fuel departments, traveling engineers and a number of delegations of enginemen and firemen, whose duties bring them directly in contact with the consumption of fuel on the locomotive.

For the first time the program this year has been grouped so that matters primarily of interest to the operating officer were discussed on the second day while those subjects of primary interest to the mechanical department were grouped together on the third day.

L. F. Loree, president, Delaware & Hudson, delivered the principal address at the opening session and his address was followed by that of the president, P. E. Bast, fuel engineer Delaware & Hudson. The program included addresses on the following subjects: How can management effect fuel economy? by A. R. Ayers, assistant general manager, New York, Chicago & St. Louis; How can fuel purchases effect economy? by H. C. Pearce, director purchases and stores, Chesapeake & Ohio, discussion of Fundamental fuel factors, by G. M. Basford, and a discussion of the relation of signals to fuel saving, by B. J. Schwendt, superintendent of signals, New York Central. Abstracts of some of these addresses and a number of important reports will appear in later issues. Following is an abstract of the address by L. F. Loree.

A look into the future

By L. F. Loree
President, Delaware & Hudson

As a lad I read a story of James Watt seated at the fireplace, watching the boiling pot, noting the lid lifted by the expanding steam, and later working out upon this hint his great invention—the steam engine.

The story was, of course, without foundation, and is typical of much purely imaginative matter that is dished up to us. Sometimes I have thought that to no inconsiderable degree the inertia and closed mind of the public is due to the mass of misinformation that is gathered in youth, and the ill result goes even farther, since there is truth in the warning of the Greek philosopher "that we should not lie to the children, if for no other reason than that when they grow up they will not believe even the truth that we tell them."

The first pumping engine

Then, in 1712, Thomas Newcomen, an ironmonger or iron merchant of Dartmouth, England, "fixed the first engine that ever raised any quantity of water, at Wolverhampton." There is still in existence an engraving of it. Looking at this drawing one cannot but be surprised at the maturity to which the engine had been brought and the wonderful achievement that it really was.

John Smeaton, a celebrated civil engineer, turned his attention, about 1765, to the atmospheric engine, and having collected data from some 100 engines, and conducted a series of experiments, set out rules for the best proportion of the parts. The effect of Smeaton's efforts, which were largely reflected in a decreased fuel consumption, is seen in comparing the results he obtained raising 9,450,000 lb. of water one foot high by a consumption of one bushel—84 lb.—of coal, as against the average of the 100 engines he examined, which gave a performance of 5,590,000 lb.

Where James Watt comes in

In 1757 James Watt was in the service of the University of Glasgow, Scotland, living and having a shop within the college walls under the title of "Mathematical Instrument Maker to the University." Here he enjoyed intercourse with professors and students interested in his branch of activities, and here he carried on many experiments with the force of steam.

The University owned a small model of Newcomen's engine, and in the winter of 1763-4 it was given to Watt to be repaired. Watt was surprised and interested by the great amount of steam consumed by the little engine, and set about seriously to investigate the matter.

Early in 1765 the idea occurred to him that the steam, instead of being condensed in the cylinder, might be drawn off into a separate vessel and there condensed. By this means the cylinder might be kept as hot as desired, the condenser as cold as necessary, no steam be wasted and a perfect vacuum obtained. At the time he secured his patent, on January 5, 1769, for "a new method of lessening the consumption of steam and fuel in fire engines," he estimated the saving of steam at one-half.

Watt's purpose was fuel economy

The extent to which Boulton and Watt were dominated by the idea of fuel economy is clearly indicated in the terms they adopted in marketing their engine. They stipulated to receive the value of one-third of the fuel saved by each engine when compared with a common one (not with Smeaton's improved engine) burning the same kind of coal, to be paid annually or half-yearly, with an option of redemption at ten years' purchase. In Cornwall a committee canvassing the situation found that the average duty of the Newcomen engine was 7,037,800 lb. raised one foot high by the consumption of a bushel—84 lb.—of coal. Boulton and Watt's low-pressure engines performed an average duty of about 18,000,000 lb.

The first engines built by Boulton and Watt were atmospheric engines, the open-topped cylinders being surrounded by a steam case, but further economy was found by covering the top of the cylinder and admitting the steam above the piston.

On March 12, 1782, Watt patented his double-acting steam engine, using the expansive force of steam below as well as above the piston, and at once solved the difficulty of applying it successfully to produce a continuous rotative motion.

Little new has been introduced in the mechanism of the engine; in its main features it is today very much as Watt

made it. Watt had mastered the difficulties in the way of employing steam at high pressure; he knew that the steam could be discharged into the open air instead of into a condenser chamber; he was alive to the availability of the expansive force of steam; but he was afraid of the danger attending its use. The materials at his disposal did not command his confidence, nor was there sufficient skill on the part of the engineman.

The commercial success of Watt's invention, designed, as we have seen, to produce an economy in fuel consumption, had been very great; but here the wealth and influence, the energy and tact of Boulton, were invaluable complements to his inventive genius.

A prediction of thirty years ago

Looking to the future, we have to form some conception as to how the coming motive power shall be designed and equipped. There is nothing at the present time that seems promising in electric, Diesel, turbine and various non-reciprocating steam engines. We must continue to fix our attention upon the reciprocating steam-engine locomotive. Here we may discern a number of factors which may be utilized to improve its service and reduce its expense of operation.

In March, 1895, Matthias N. Forney, the author of "The Catechism of the Locomotive," writing as editor in the American Railroad Journal and Engineering Magazine, said:

> Let it be assumed that the fuel consumption on a road is represented by $1,000,000; if 14 per cent was saved by simply testing it and learning which was the best quality to buy, the $1,000,000 would be reduced to $860,000. If, now, we save 10 per cent by an improved valve gear, the million is reduced to $774,000. If feed water heaters should save 14 per cent, then the cost of fuel would be lowered to $665,640; and if superheated steam should fulfill its promise of 30 per cent saving, the fuel account would be brought down to $532,512.

In 1915 the typical large freight locomotive of The Delaware & Hudson was its Class E-5 of the consolidation type, using saturated steam, slide valves and single expansion cylinders, carrying 210 lb. boiler pressure, weighing 227,200 lb. on driving wheels, and rated at 50,600 lb. tractive force. In moving 1,000 actual gross ton-miles, including its own weight, on a 0.5 per cent grade, at average freight train speeds, this locomotive consumed 160 lb. of coal. The first marked improvement was the application of superheaters and the substitution of piston valves for the slide valves, increasing the weight of the engine on the driving wheels to 231,700 lb., and the tractive force to 55,100 lb., and reducing the fuel consumption under like operating conditions to 130 lb. of coal, or by about 19 per cent.

What the "Horatio Allen" has done

Last year we developed a type of consolidation locomotive, changing the E-5 class as little as was necessary, which we named the "Horatio Allen," after the engineer who ran the first locomotive in this country. This locomotive carries 350 lb. boiler pressure, weighs 298,500 lb. on the driving wheels and has developed 75,000 lb. drawbar pull, as measured by the dynamometer. The "Horatio Allen" uses a moderate degree of superheated steam admitted to and exhausted from the multiple expansion cylinders through large valve and port openings. It has a water tube type of firebox with extraordinarily large evaporation surface and a fire brick baffle wall extending the full width and length of the firebox which insures full utilization of the hand fired coal, with long flame travel, securing maximum radiant heat effect and minimum cinder and stack losses. With this engine 1,000 actual gross ton-miles under like conditions require 55 lb of coal.

It is probable that within the year a satisfactory feed water heater will be on the market and that the equipment for burning coal pulverized to about the fineness of talcum powder will be brought into practical use.

Possibilities of the next ten years

Looking over this score of years from 1915 to 1935, and following Mr. Forney's example, the following changes may be anticipated during the next ten years:

Typical steam locomotive coal consumption per 1,000 actual freight train gross ton-miles on equivalent to a 0.5 per cent grade

Year 1915		160 lb.
Reduction in total fuel consumption by means of—		
1. Superheating	to	130 lb.
2. Fire brick baffle wall	to	124 lb.
3. Feed water heating	to	113 lb.
4. 350 lb. boiler pressure	to	96 lb.
5. Improved boiler design, circulation and evaporation	to	84 lb.
6. Multiple expansion cylinders	to	70 lb.
7. Improved steam distribution and reduced cylinder back pressure	to	60 lb.
8. Burning powdered coal in suspension	to	44 lb.
9. Reheating of high pressure exhaust steam in multiple expansion	to	42 lb.
10. Miscellaneous items, such as increased train loading through the use of an auxiliary locomotive, utilizing the dead weight of the tender for tractive purposes, greater sustained boiler horsepower capacity, substitution of poppet valves for piston or slide valves, and higher superheat on account of the use of powdered coal, may bring the final figure down to about		38 lb.

This is somewhat less than one-quarter of the 1915 locomotive fuel consumption. The effect of this would be to reduce the 90,000,000 tons of fuel now used in freight train service to about 27,000,000 tons, effecting a total economy of something like $200,000,000 per annum.

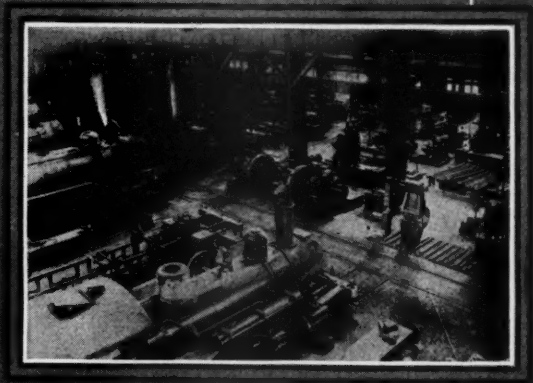
I have had these figures carefully checked with available cost and performance sheets of various railroads, with dynamometer-car road and other tests made by various steam roads, and with laboratory tests made at Purdue University, University of Illinois, and the Pennsylvania, at Altoona, Pa. Discussing them with my own people, they do not seem to me extravagant. There are, of course, debits to be set off, the cost of these appliances and their upkeep, determinable only by experience. But the possible savings are large, and that they will not be confined to those I have listed, no one can doubt.

The joy of our occupation is not alone in the service we render but in the knowledge that the industry is alive and vigorous, expanding and improving, exacting from us our utmost effort, inviting every exertion from the dullest of routine duties to the liveliest flights of the imagination. Let us enjoy fully the opportunities it offers, meet adequately its drafts upon us and demand for it the respect it merits from those it serves.

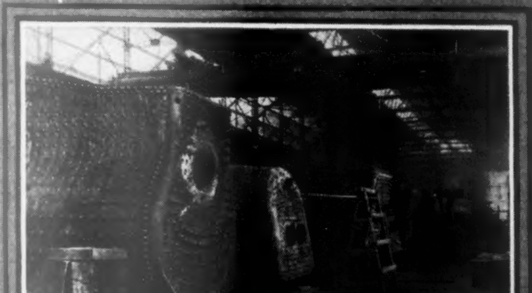
Closing business

At the closing session of the convention, the following officers were elected for the ensuing year: President, J. W. Dodge, Illinois Central; vice-presidents, E. E. Chapman, Atchison, Topeka & Santa Fe; W. J. Tapp, Denver & Rio Grande Western, and J. E. Davenport, New York Central. The following were elected members of the Executive Committee to serve two years: W. G. Black, New York, Chicago & St. Louis; T. F. Carbery, Missouri Pacific; Carl B. Smith, Boston & Maine; J. J. Stahl, Southern. C. H. Dyson, Baltimore & Ohio, was elected to serve one year.

In the ballot taken to indicate the perference of the association for the next meeting place, Chicago received the highest number of votes. Final decision, however, rests with the Executive Committee. The Executive Committee has already announced the tentative dates for next year's convention as May 11 to 14, inclusive, two weeks earlier in the month than this year's convention.

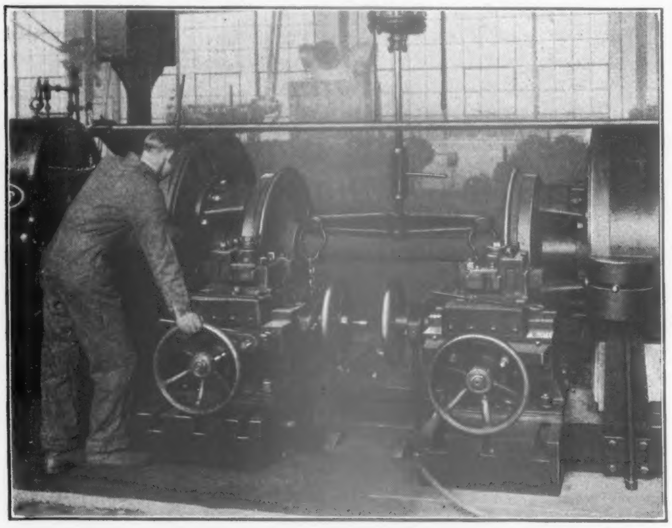


New and Improved Machine Tools
— and —
Shop Equipment



Car wheel lathe of the open center type

A HEAVY car wheel lathe of the open center type has been recently placed on the market by the Niles-Bement-Pond Company, New York. It has a capacity to turn wheels, from 26 to 52 in. diameter on the tread, when mounted on axles having either inside or outside journals. In designing this machine special care has been taken to eliminate all unnecessary power losses



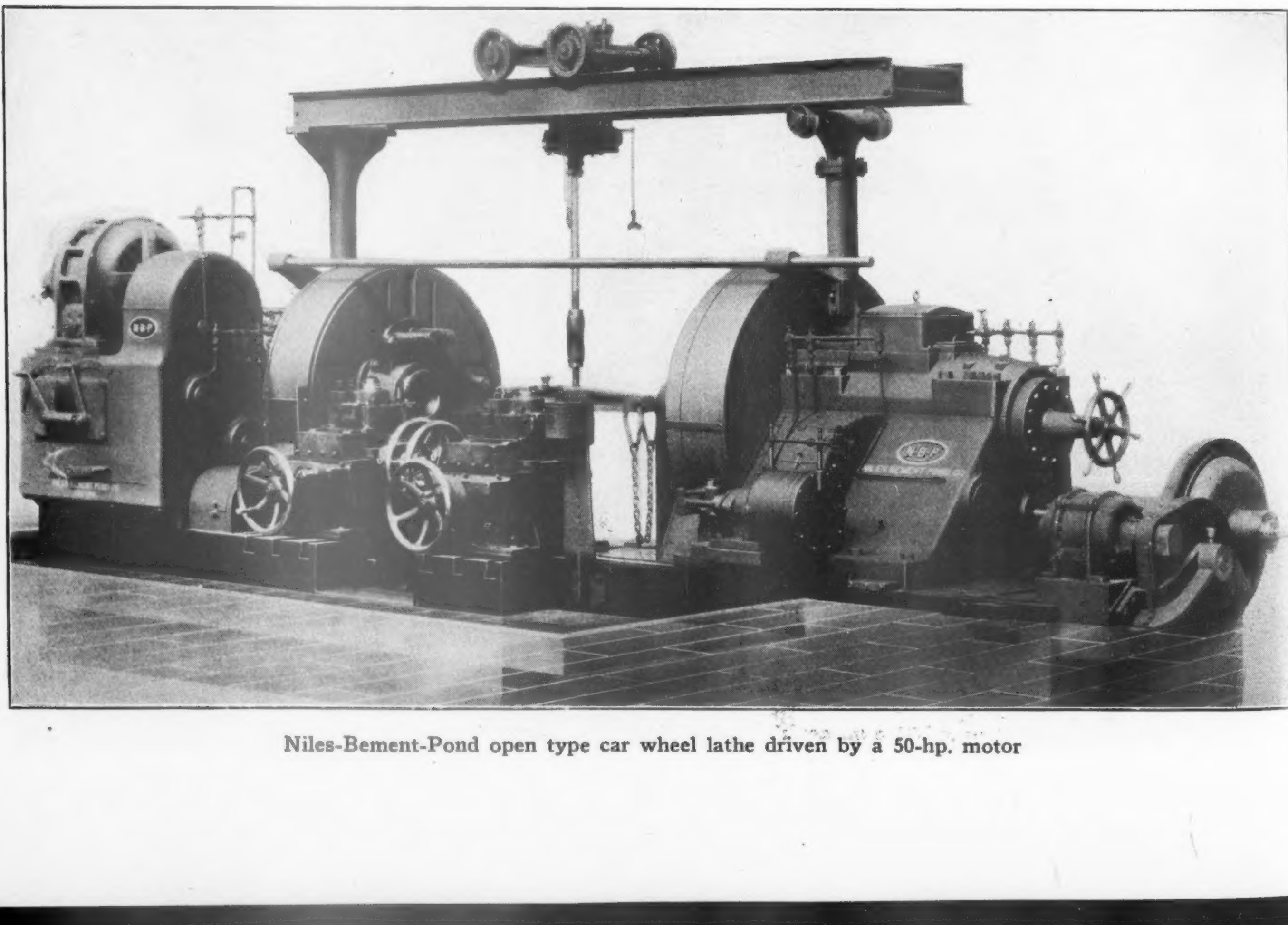
Control levers arranged for the convenience of the operator

so that the maximum power available can be delivered at the tools. The main driving gears have been so arranged that the spindle bearing pressures are greatly reduced—the internal gear face plate drives are claimed to be exceptionally efficient and all heavy end thrusts are taken up by ball bearings.

This lathe is considerably heavier and more powerful than any machine of this type previously built by this company. Its production is limited only by the present day high speed steel used and a reserve capacity capable of taking care of a 50 per cent increase in the quality of tool steel has been built into the machine. The unit system of construction has been adhered to, making all parts very accessible. The most modern and improved time and labor saving devices such as power traverse and clamping to the sliding headstock, semi-automatic driver dogs, wheel hoist, turret tool posts, and automatic lubricating system are included.

The machine is driven by a 50 hp. motor mounted on the drive box with which it forms a self-contained unit. The drive box is totally enclosed, jig drilled and planed so that a speed box of the constant speed or adjustable speed type is interchangeable with the headstock. All gears are of steel with wide faces and coarse pitch. They are mounted on large diameter shafts which run in bronze bushed bearings of liberal proportions. All overhung gears have been eliminated and each gear is mounted against a shaft bearing.

Both headstocks are of massive construction. The left headstock is stationary and is rigidly bolted to the bed while the right hand headstock is movable and is adjusted to a sliding fit on the bed. It is secured to the bed both front and back by long shoes sliding in large tee slots, the clamping surfaces of which are provided with renewable steel liners. The face plates, one on each head, are mounted on extra large spindles and are driven in unison by steel internal gears securely bolted to them. The driving pinions are forged steel and are mounted on an auxiliary shaft located at the front of the machine about on a line with the tools. This construction decreases the torsional strains on the drive shaft and tends to counteract cutting strains, thus reducing the pressure on the main spindle bearings. A large self-alining ball thrust bearing takes the end thrust of each spindle.

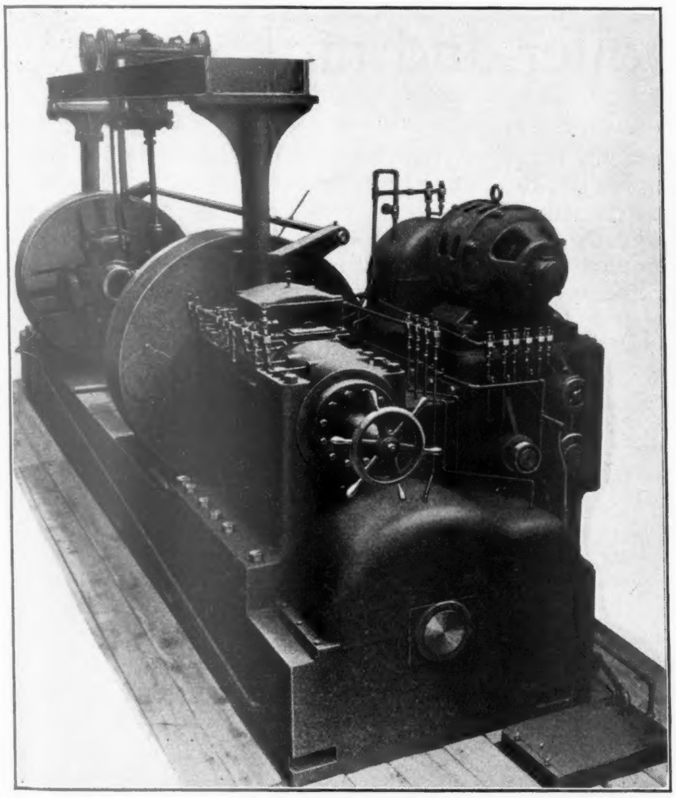


Niles-Bement-Pond open type car wheel lathe driven by a 50-hp. motor

These bearings, it is claimed, absorb but one-seventh of the power consumed by a plain step bearing. They reduce the power loss through friction and increase the power delivered at the cutting point of the tool. Four semi-automatic drivers are fitted on each face plate and firmly grip the rims of the wheels. These drivers are adjustable radially for different wheel diameters.

The right hand headstock is traversed along the bed by power through a large screw driven by a separate motor located at the end of the bed. A self-alining ball bearing takes the thrust from this screw. A safety feature, called a torque limiting friction, is located on the end of the screw. It can be so adjusted that the drivers on the headstocks can be brought up against the wheels with just the proper amount of lateral thrust to grip the wheels firmly. When the headstock is withdrawn this slip friction becomes a positive clutch. An electric switch acts as a safeguard against accident by limiting the lateral motion of this headstock. Pneumatic power clamps, one at the front and one at the back, clamp the right hand headstock to the bed simultaneously. If air is not available an electric clamp can be used.

The bed is of exceptionally heavy, deep box section and is reinforced at suitable intervals by rigid box braces.

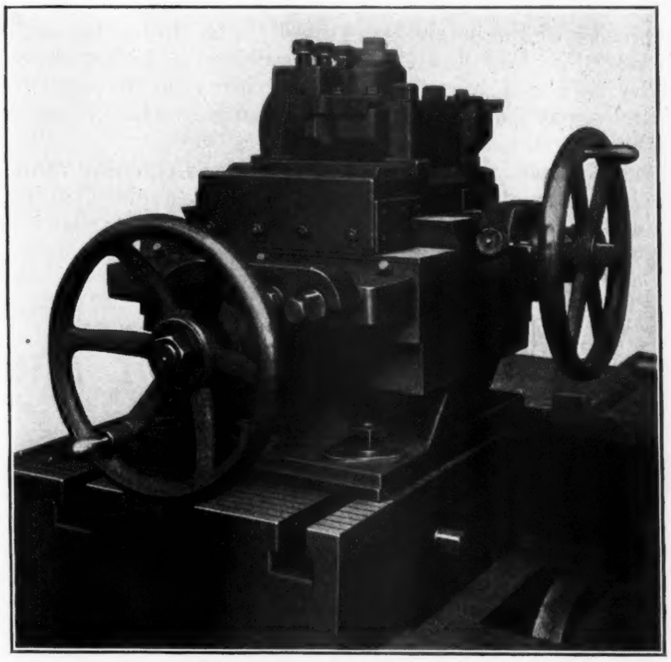


End view of car wheel turning machine, showing lubricating system

The flat ways on the right hand end of the bed which are subject to wear from the sliding headstock, are provided with renewable steel wearing plates. The left hand end of the bed projects beyond the driving head to accommodate an out-board bearing for the large driving gear on the drive shaft and its pinion.

The lathe is thoroughly lubricated. A special automatic lubricating system has been developed which greatly reduces friction, power consumption and should greatly reduce expensive repairs, shut-downs and maintenance. A geared pump keeps the oil level in a large tank located in the upper part of the drive box filled to the high level of the lubricating system. From this tank, trunk lines carrying adjustable sight feed lubricators supply each bearing with the proper amount of oil. The gear trains are continuously flooded with an unrestricted flow of oil. All used oil from both headstocks drains to a reservoir under the floor where it is filtered and again pumped to the upper tank for circulation.

A new design four sided flat turret tool post carries the four cutting tools for roughing, flange roughing, flange and tread finishing, and chamfering operations. Each tool, when indexed, comes into its cutting position



The left hand headstock, showing the arrangement of the tool holder

with a minimum amount of horizontal adjustment. Tool blades are securely clamped to the tool blocks and can be quickly removed for sharpening or replacing. Each tool post is mounted on a lateral feed slide which fits into the top surface of a cross feed slide. The wearing surfaces of both cross slides and lateral feed slides are covered by renewable hardened steel plates. The cross slides provide in and out adjustment for setting the depth of cuts. They are mounted directly on top of heavily built bases which are adjustable on the bed by rack and pinion to accommodate different size wheels. Four bolts clamp each firmly to the bed when set in the desired position.

There are power lateral feeds to both right and left hand tool rests. The feed ratchets are totally enclosed and so arranged that the feed may be thrown on or off by means of a pawl which also controls the direction of the feed. A feed change disc readily accessible to the operator makes it easy to change to any of the six available feeds which vary from 3/32 in. to 9/16 in.

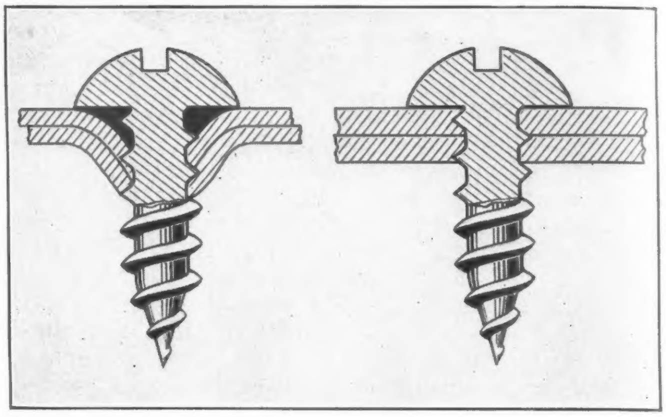
Short ends of tracks, attached to a steel telescoping cover which extends between the face plates, line up with the shop tracks when the movable headstock is in the charging position. Wheel sets are then rolled in and raised by a pneumatic hoist for chucking. A calipering device consisting of an adjustable pointer on a bar rigidly supported by the headstocks makes it easy to turn both wheels to the same diameter.

Self-tapping hardened steel sheet metal screws

SELF-TAPPING, hardened steel screws have been designed expressly for sheet metal work by the Parker-Kalon Corporation, New York. They differ from the ordinary wood screws in that they have a straight body and a special thread which extends all the way to the head so that the screws can be driven until the head is flush with the metal. The screws are hardened by a process which makes it capable of cutting into sheet metal without injury to its thread.

To use these screws it is only necessary to punch or drill a hole through as many sheets of metal as are to be held together. The hole must be a trifle smaller than the diameter of the screw being used. The tip of the screw is placed in the hole and the screw driven in with a screw-driver. The tighter the screw is driven, the stronger the fastening is made. This method eliminates the necessity of tapping the sheets.

The screws can be used in such work as patching roofs, car interiors, etc., repairing water tanks, fastening lagging thimbles to engine jackets, and erecting and repairing sheet metal work around shops, building, etc. The screws are made in six different sizes each of which can be furnished with round or flat heads.

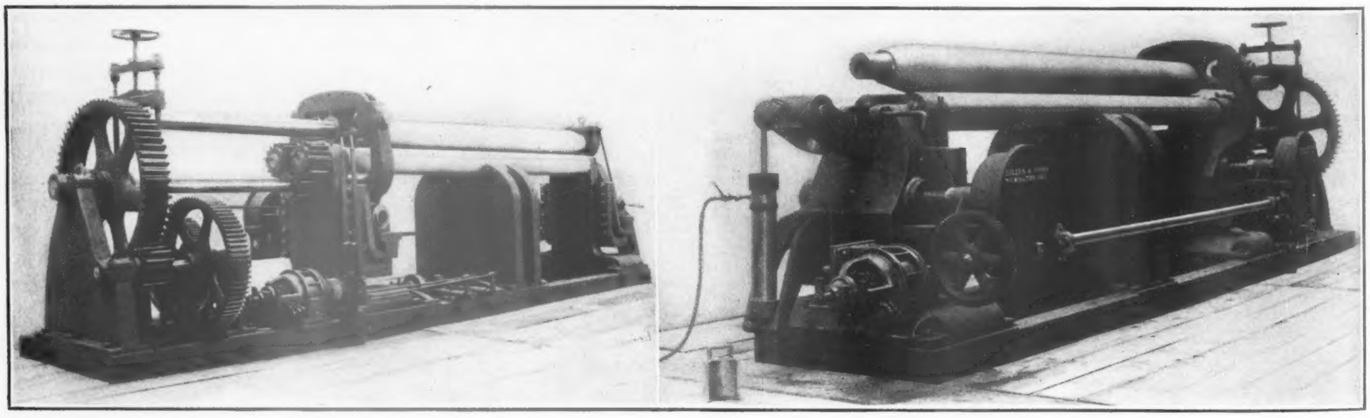


Sheet metal screws which cut their thread as they are driven through the metal sheets

Bending rolls for the boiler and tank shop

ONE of the most troublesome problems in a tank and boiler shop is the flat place that is usually left on the edges of plates after being rolled on plate bending machines. Various methods of curving these edges have been employed for years, one the use of a heavy press, another mauling, and another the use of forming blocks on pyramid type rolls.

For a number of years the Hilles & Jones works of the Consolidated Machine Tool Corporation, Wilmington, Del., has been trying to evolve a plate bending machine, that would curve the sheet completely to the edge so that if desired the two edges may be welded, making a full cylindrical surface without any further work. Such a machine has recently been developed.



Front and rear views of bending rolls which curves the sheets completely to the edge

The capacity of the machine is rated to roll ⅜-in. soft plates 14 ft. wide, or corresponding duty, and the same type of roll is made in other sizes. On the particular machine mentioned, the upper roll is 13½ in. in diameter and is adjustable vertically to provide for pinching the plate and also has horizontal adjustment so that it may be brought over to the center of either one of the lower rolls. It is this combination of the vertical and horizontal adjustment for this upper roll that provides the means for bending a plate to a true radius to the edge. The top roll is also provided with a solid forged extension for counterbalancing it when the back housing is dropped down for the removal of plates rolled to full circles.

The mechanism operating the vertical adjustment of the upper roll is such that both ends of the roll are raised and lowered simultaneously or each end independently. Positive clutches provide for this arrangement and there is a vertical adjustment of 4 in. to the upper roll. The horizontal adjustment of the upper roll is 14½ in., or 7¼ in. each side of the center. The adjustments of the upper roll are by independent 10-hp. motors, one motor for the vertical adjustment and another for the horizontal adjustment. This is necessary to provide an independent flexible control for the two motions. The lower rolls are each 10½ in. in diameter, with a center to center distance of 14½ in.

An important feature of this design is the air cylinder which is provided for lowering the yoke for the removal

of plates rolled to full circles. This air cylinder serves to eliminate the use of a crane, which is the usual practice for lowering the yoke, and this one feature materially increases the speed at which plates may be handled through the machine. The plate travel is 15 ft. per min. The driving of the lower rolls is by a 20-hp. reversing motor.

Worm and worm wheel drives are used for both the vertical and horizontal adjustments of the upper roll. Each worm and worm wheel are totally inclosed and run in oil. All gears have teeth cut from the solid. The weight of the machine without electrical equipment is 72,000 lb.

Bullard power operated chuck

ANY analysis of machining time on chucked work includes, in the aggregate, a considerable amount of time required to chuck the piece in either standard chucks or fixtures. While the function is, of course, necessary to production, it is not directly productive and any saving which is made decreases idle time and increases productive time. On single spindle machine tools, chucking time is a definite factor in the process no matter what portion of the productive time it comprises. In the multiple spindle machine, where loading is done simultaneously with machining, this factor only becomes important when the rate of machining crowds the operator beyond his capacity.

As a definite step forward in the elimination of idle time and constructively increasing machine production, power chucks of various designs have been used. Some of them have been designed to reduce only the fatigue factor in the operation, while others have made definite steps toward increased production and greater economy in the process. The design of a power chuck should provide for only a simple motion by the operator. Its action must be positive and dependable while its mechanism must remain simple and of ample strength. Insofar as possible its complete function should be self-contained with power derived from the same source as the machining function rather than dependent on accessory or external forces which may be subject to fluctuation and interruption separate from the primary machine operation. A power chuck should also permit a definite control of the gripping power exerted on the work; for proper chucking requires simply the holding of a piece against the machining operation, and both accuracy and efficiency of the job may be as adversely affected by over-chucking as by insufficient support against the cutting operation.

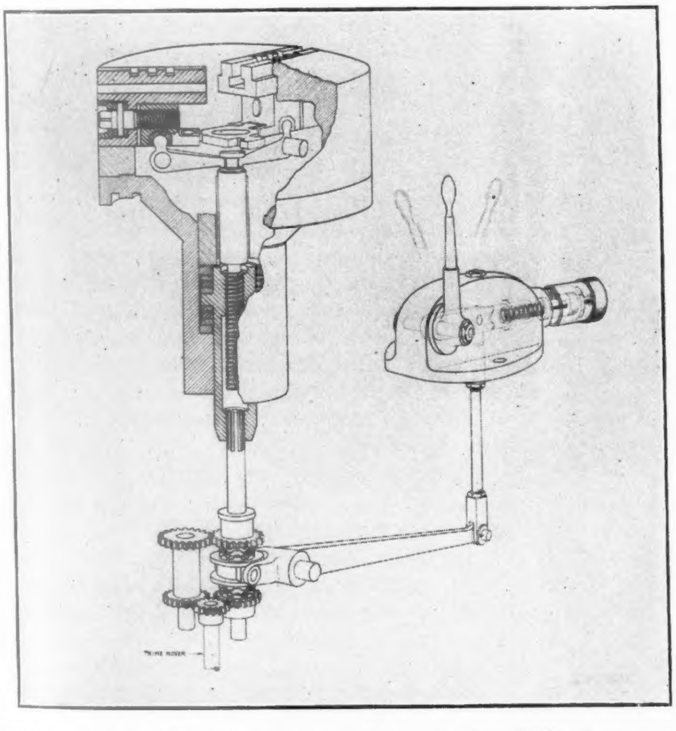
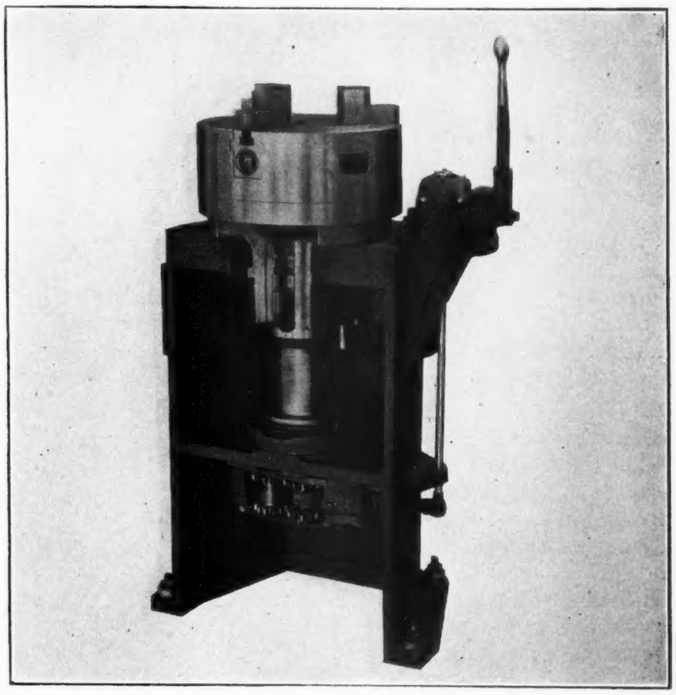


Diagram showing the construction of the Bullard power operated chuck

With these points in mind, a power chuck has been designed by the Bullard Machine Tool Company, Bridgeport, Conn. and placed in used on its various types of machines. The primary actuating motion of the mechanism is a vertical pull exerted by a screw and nut. This motion is transferred to the three jaws of a standard chuck by a bell crank lever and may also be adapted to the operation of special fixtures designed with its use in mind. The construction, as shown in the illustration, clearly indicates that when once the pressure is set by power it cannot be released except by reversing the motion. Its operation is controlled by a double clutch with angular teeth and compound gears which provide power in either direction from a common source. The driven member of the clutch is brought in contact with either forward or reverse drive by connection with a hand lever operating through a dart. The spring tension is so calibrated as to actually weigh the load of the pressure on the jaws. In operation it is simply necessary to throw the lever engaging the clutch for either forward or reverse

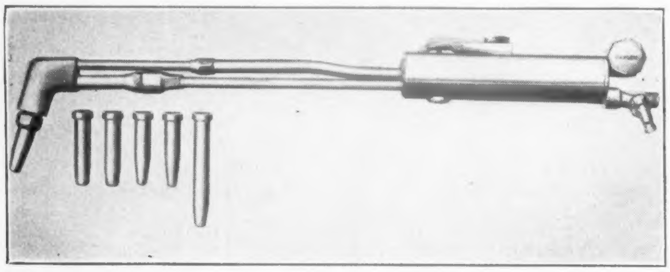


Power chuck which receives its primary actuating motion through a screw and nut

movement. The clutch is automatically disengaged when the movement has been accomplished; and it is impossible to build up an excessive jaw pressure by holding the clutch lever in the engaged position. The time required for operating the chuck in either direction is two seconds.

Low pressure cutting and welding torch

A LOW pressure torch which will operate on either low or high pressure gas with equal efficiency is being manufactured by the Alexander Milburn Company, Baltimore, Maryland. It is especially constructed to operate with the low pressure acetylene gas, city gas or hydrogen. It may also be used with a low pressure acetylene generator.



Low pressure torch provided with solid copper tips

The manufacturer has utilized in the design of this torch the various parts of its standard cutting and welding torches. A correct and intimate mixture of the oxygen and acetylene has been obtained with non-flashback qualities. The torch may also be adapted for welding as well as for cutting by the interchange of tips. It is claimed that it can efficiently perform practically all the cutting and welding operations within range of the process.

It is constructed of bronze forgings and special seamless tubing, designed to withstand constant service. The tips are made of solid copper and are interchangeable on a large number of low pressure torches of other makes.

Band saw adaptable for motor drive

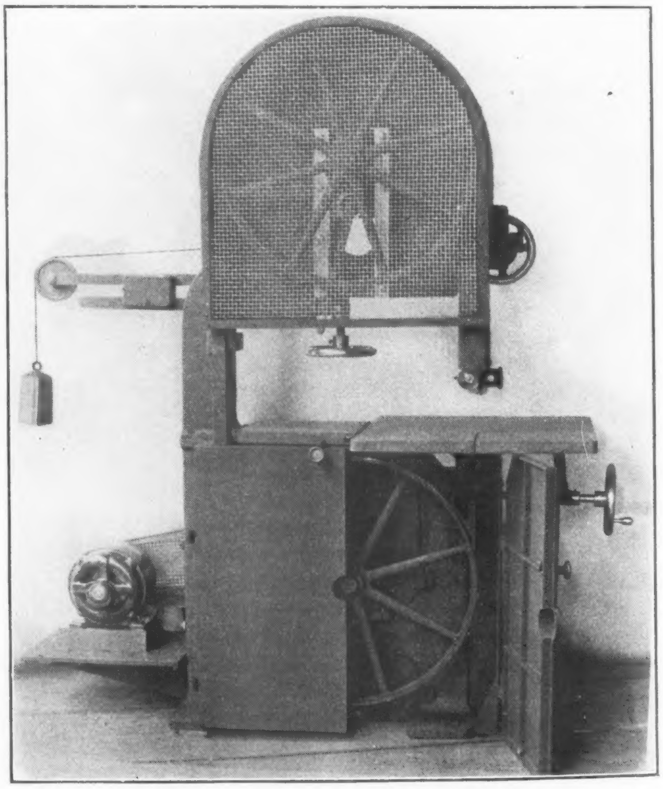
A LINE of band saws of improved design has recently been brought out by the American Saw Mill Machinery Company, Hackettstown, N. J. This line includes various sizes ranging from 20 in. to 36 in., the 30-in. size of which is shown in the illustration. These machines have been designed with the principal objective of providing convenience of operation, accuracy and durability. The design for all sizes is massive and the column and frame is of sufficient weight to insure against vibration.

The upper and lower wheels for the 30-in. size are of the solid spoke type 30 in. in diameter and have a 2-in. face. The manufacturer has also provided an optional design in which, if preferred, the lower wheel can be equipped with a special brake attached to the bolt shifter to stop rotation of the wheel quickly. Both wheels are keyed to ground steel shafts. The collar is forged solid on each shaft against which the hub of the wheel is firmly held by a large nut. Both the top and bottom shafts run in extra long bearings, made in two parts to take up the wear and are adjustable to provide for alinement of the saw blade. The upper wheel bearing is hinged for tilting of the wheels by means of a lever located in a position convenient for the operator.

The saw guide is of a special anti-friction design and is mounted on a counterbalanced square post. A hand wheel is provided for raising and lowering the guide post with one hand so that the workman may devote his entire attention to the work. The straining device for the upper wheel is of wide range and is sensitive due to the use of both a spring and weight. The slide head which carries the upper wheel bearings slides in a groove in the column and is held in place by steel gibs.

The table is 20 in. by 32 in. and is made rigid by extensive ribbing on the underside. It is cast face down to insure a clean surface and after being machined is scraped and polished. A hand wheel and screw are provided for tilting the table to 45 deg. for bevel sawing and it is equipped with a brass index and pointed to register its position. A lock fastens the table in any position.

As shown in the illustration, the various moving parts of the band saw are well guarded. The front side of the upper wheel is protected by a hinged wire guard and iron doors are provided for the lower wheel. The saw is fully protected by the upper and lower guards in the rear and a guard follows the guide in front. An iron cover is also provided to enclose the machine back of the wheels. The lower pulley and belt are protected by wire mesh.



Motor driven band saw fully protected with safety guards

A feature of this machine is the provisions made for motor drive. A two or three horsepower motor is recommended to operate it. The two-horsepower size is sufficient for ordinary shop work, but the three-horsepower is recommended for heavy work. The design is such that the motor can be set on the floor and bolted to a pulley drive or set on a special bracket attached to the body of the machine and provided with a gear drive.

A 26-in. high power turret lathe

THE International Machine Tool Company, Indianapolis, Ind., has developed a 26-in. high power turret lathe of improved design. The general description of this machine is somewhat similar to the general purpose lathe of the same size which has been manufactured by this company for some time. The method of drive and the design of the headstock has been changed, making the drive more direct. The general method of feeds, speeds and rapid traverse for the tool post and the turret are the same as in the older machine.

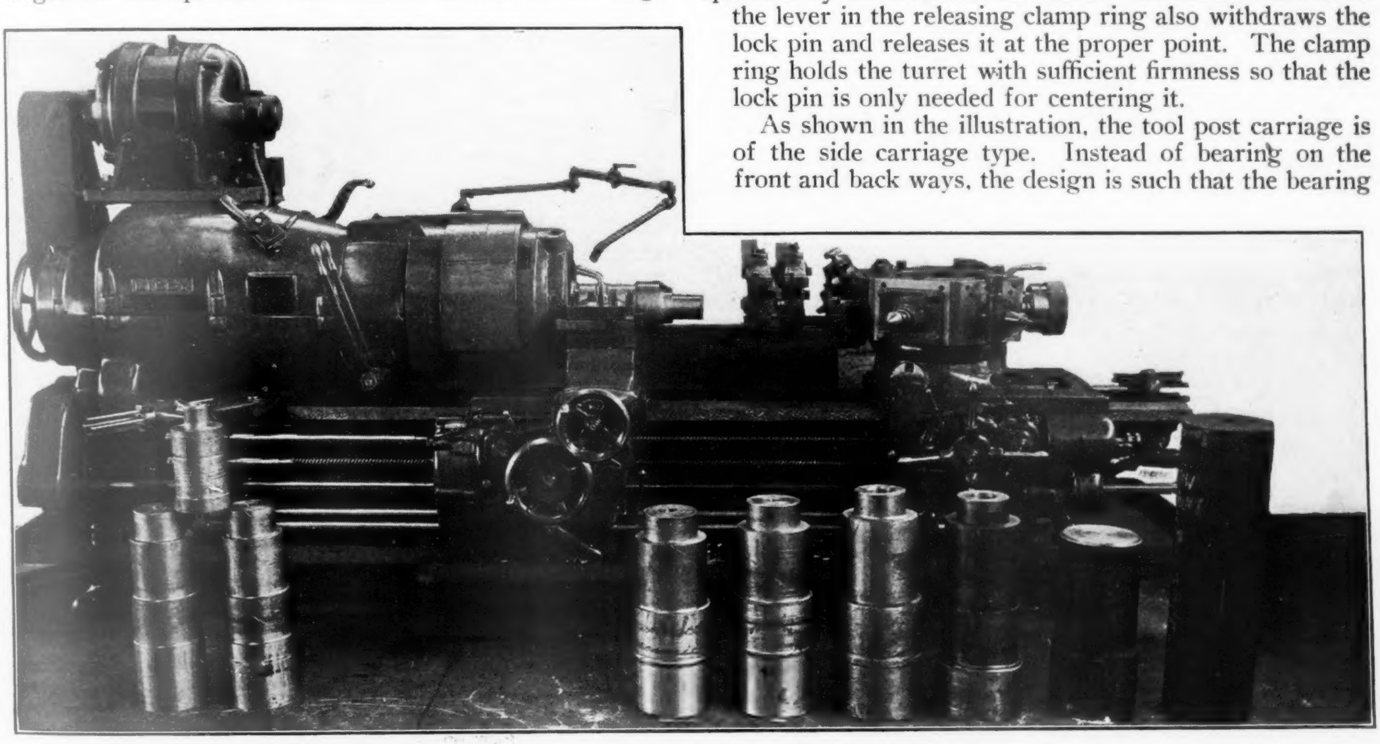
The gears in the headstock are made of steel with a wide face and course pitch. The two driven gears on the spindle are located one on either side of and close to the front main bearing. The chuck ring gear is 22 in. in diameter, keyed and bolted solidly to an 18½-in. flange, forged on the spindle. The friction drives are of large diameter and are located on the high speed drive shaft. Eight gear ratios are available ranging from 3.36 to 1 up to 57.6 to 1. The spindle and shaft bearings are of phosphor bronze. The main spindle bearings are adjustable for wear and are equipped with ring oilers. The point of the spindle is of .50 per cent carbon steel and the nose is threaded to receive the chuck. The seat is tapered so as to centralize the position of the chuck which is of special design and has three 23-in. movable jaws.

The bed and bedstock housing is in one casting. The bed is cross-ribbed every 11 in. and has a longitudinal rib through the center. The ways are of flat design, the front way being 6 in. wide and the back way 4½ in. wide. These ways provide a wide bearing surface for the carriages, the design of which is such that the force of the cutting strains on the spindle is transferred direct to the ways. The front way is undercut 15 deg. to receive the long taper gib for both the tool posts and turret slides, which takes care of the side thrust of both carriages. The turret slide is of heavy construction, 30 in. long and having 315 sq. in. of bearing surface on the bed. It is gibbed to the front way by a long taper gib and is also gibbed to the underside of the ways. A positive clamp to hold the slide stationary when using the centers is also provided.

The turret is a hexagon 18 in. across the flats and has six 4¼-in. holes. The faces are 9 in. wide by 8 in. high. The turret rests on a base 17 in. in diameter which is centralized by the cone seat. It can be securely clamped on the outside diameter of the seat by a double clamp ring operated by an eccentric and lever. A similar action of the lever in the releasing clamp ring also withdraws the lock pin and releases it at the proper point. The clamp ring holds the turret with sufficient firmness so that the lock pin is only needed for centering it.

As shown in the illustration, the tool post carriage is of the side carriage type. Instead of bearing on the front and back ways, the design is such that the bearing on the back way is transferred to a taper gibbed bearing on the bottom of the front side of the bed. The 15-deg. undercut on the front way permits the tool posts to pass the chuck and permits turning and facing it up to the full swing of the machine. This design also allows the turret to be moved up flush with the chuck so that short stocky tools instead of long overhanging tools may be used. The tool post is of steel and will carry four tools at one time, each independently adjustable for height. It can be locked in any of the four positions and clamped in any desired intermediate position by means of a double acting clamping device.

Independent power rapid traverse is provided for each carriage. The carriages can be operated in either direction at a rate of 35 ft. per minute. None of the head-



Libby turret set up for turning out locomotive crank pins

stock or feed gears are used in the rapid traverse feed mechanism. The slides are operated by means of a hand wheel on the tool post slide and pilot wheel on the turret slide. One revolution of either wheel will advance the slide one inch. The power feeds are gear driven, the feed changes being made in the apron. The feeds for the turret and tool post carriages are independent of each other both as to direction and amount. They can also be reversed independently in either apron. All gears in the headstock are either steel or semi-steel. The gears in the aprons are of steel and are bronze bushed or run on hardened pinions. All gears and pinions are heat treated. Force feed lubrication is provided to all main bearings of the machine.

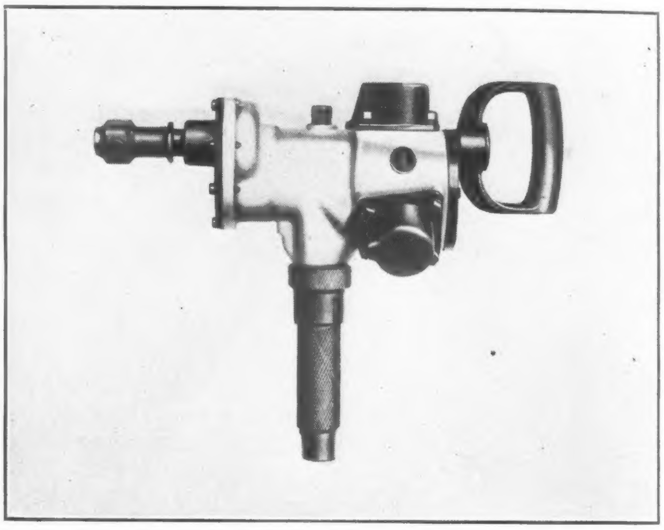
Pneumatic wood boring drill

A LIGHT, reversible wood boring machine has recently been placed on the market by the Ingersoll-Rand Company, New York, which is suitable for boring holes in wood up to 1 in. in diameter and is known as the size DD drill.

The features of this type of machine are briefly a special three-cylinder motor, a light weight aluminum case with steel bushings cast in place in all the bearing holes and the throttle hole, a renewable crank pin sleeve and cast iron cylinders which are renewable and interchangeable. The renewable cylinders permit any one cylinder to be easily replaced. The rotating parts of the three-cylinder motor are all accurately balanced, which eliminates vibration and reduces the wear and tear on the machine. All of its parts are readily accessible for inspection.

These drills are furnished with a spade handle and a bit chuck; a breast plate or feed screw can be substituted in place of the grip handle when so desired and a drill chuck in place of the bit chuck. The drill is thus made adaptable for a wide variety of work.

The following are a few of its specifications: Average working speed, 705 r.p.m.; total weight, 15 lb.; length of feed with feed screw, 2½ in. length overall (with grip handle), 15 in.; distance from side to center of spindle, 1 9/16 in.; size of hose recommended, ½ in.



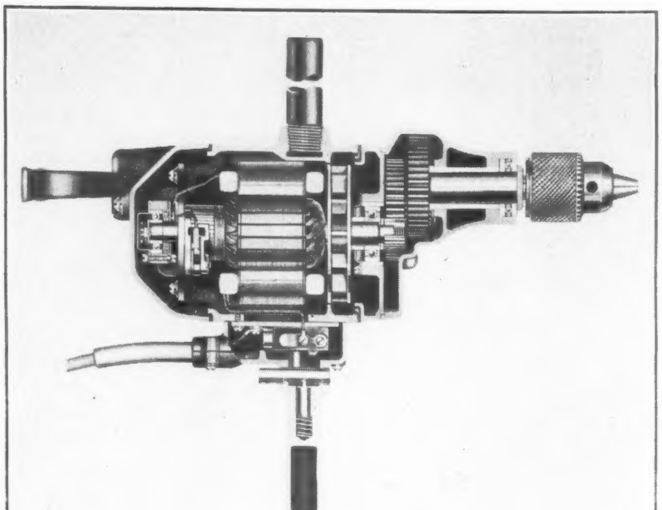
Ingersoll-Rand, three-cylinder wood boring drill

Standard duty half-inch universal drill

A STANDARD ½ in. universal drill is a recent addition made by the Hisey-Wolf Machine Company, Cincinnati, Ohio, to its list of portable electric machine tools. It can be furnished with either a 115 or 230-volt motor with a no-load speed of 525 r.p.m. capable of drilling or tapping steel up to ½ in.

The motor is designed particularly for electric drill service. The armature is hand wound with the lead ends firmly banded in place. The heavy armature runs in ball bearings which cannot slip, as the inner races are locked. The bearing on the gear end of the armature is mounted with a floating fit in a hard cast in sleeve, which is intended to obviate binding and internal friction. A tooth type stator gives an efficient magnetic flux distribution. The brush holders with an adjustable spring tension are mounted as a separate unit on a bakelite yoke. This arrangement permits brush adjustment when necessary. At each end of the motor shaft are felt washers for retaining the lubricant. They are firmly held between steel collars to prevent them from working loose or wedging. The motor is cooled by force ventilation drawn into the motor by a fan keyed on motor shaft.

The electrically heat treated gear on the armature shaft is removable. The spindle gear is carried on an over-size chuck spindle which is hardened and ground and automatically lubricated through the gear case. The chuck end of this spindle runs in over-size thrust bearings. The chuck is fitted to a hardened and ground tapered spindle. The Jacob's chuck is standard equipment.

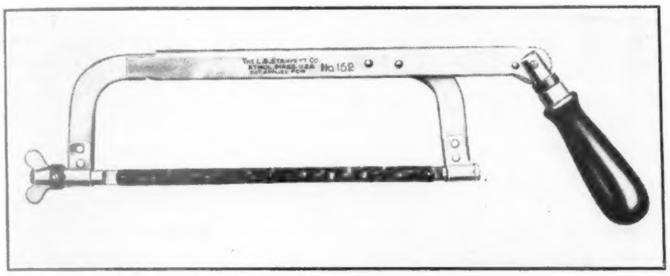


Removable end plate provides easy access to the motor of this machine

The end cover is a separate piece which carries all of the pressure applied to the spade handle, and being independent of the motor and motor bearing, relieves them of all strains. This construction also affords a convenient access to the carbon brushes for adjustment or renewal by the removal of three screws. The spade handle is directly in line with the drill chuck which tends to eliminate side pressure and reduce friction. For close quarter work it can be removed and the pressure applied directly on the end cover casting.

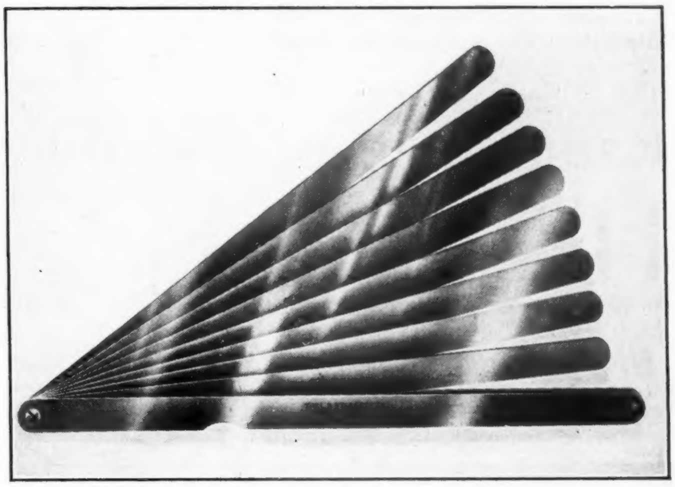
Starrett feeler gage and hacksaw frame

RECOGNIZING the demand, created by the maintenance of the many gasoline motors recently acquired by the railroads and in a lesser degree by the repair of machine tools, for a long leaf thickness or feeler gage, the L. S. Starrett Company, Athol, Mass., has brought out such a gage with eight leaves in the following thicknesses: .002 in., .003 in., .004 in., .005 in., .006 in., .008 in., .010 in. and .015 in. The leaves are ½ in. wide and 9 in. long and should one become damaged it can be easily replaced. The possibilities of this gage will be particularly appreciated when regrinding motor cylinders to take over size pistons.



Hacksaw frame the handle of which can be adjusted to 13 positions

Another tool of interest to those repairmen whose work calls for the use of a hand hacksaw in cramped quarters or strained positions, is the hacksaw frame shown in one of the accompanying illustrations. It will take any length of blade from 8 to 12 in. and has a handle which may be adjusted to 13 positions in each of which it may be locked. The saw may also be quickly set to cut in any one of four directions with respect to the plane of the frame.



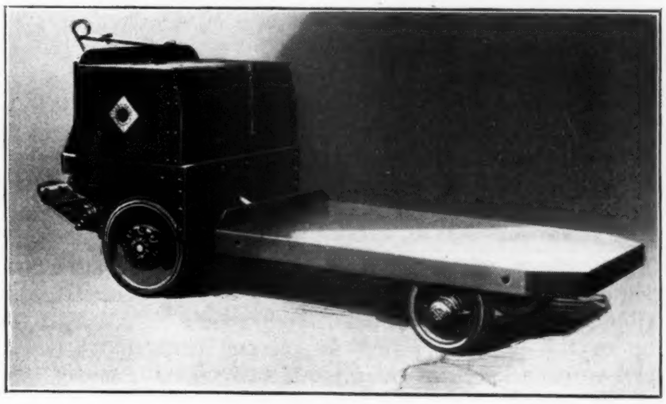
Feeler gage with unusually long blades

Large capacity electric lift tractor

THE success of the electric lift tractor within buildings has tempted many users to increase the range of this type to more distant points on the premises where runways are in poor condition. In most instances this has required the extension of runways, although some concerns have not given proper values to such improvements. On the other hand, yards and storage spaces often are so extensive that the laying of ideal trucking surfaces would possibly require a prohibitive investment.

The improvement of the trucking device has kept pace with the encouraging interest taken by the average user in its employment. The Elwell-Parker Electric Company, Cleveland, Ohio, has developed a heavier unit of the electric lift-type especially suited to travel runways not altogether smooth. This haulage unit is of broader gage than those designed particularly for inside operation. The gage of the front and rear wheels is the same, i.e., 30 in. They are fitted with 22 in. drive and 15 in. front wheels and with either 3½ in. or 4½ in. tread. The drive wheels are equipped with double row ball bearings weighing 13 lb. each, and radial and thrust bearings measuring 7 in. in the outside diameter.

These wheels are carried on drop forged knuckles with drop forged levers pressed on tapered serrations, assuring a firm union of the two. These knuckles support the weight of the axle, frame and load on a steel ball bearing recessed in a cup at the upper ends. The levers are fitted with ball ends received in the steering rod sockets. All the rods are placed high beneath the platform to avoid contact with obstructions on runways. The full-floating, alloy steel, drive shafts are pressed into drop forged clutch



Electric lift tractor specially suited to travel over uneven runways

plates bolted to the outside of the drive wheels, these shafts being fitted with chrome-vanadium universal joints and engaging the splines of the differential.

An innovation in tractor design is found in the all-drop forged differential. The differential carries a special Brown & Sharpe phosphor bronze worm wheel, lock bolted between the two halves of the drop forged differential cage. A multi-thread steel worm on radial and thrust bearings with the above parts of the differential, are assembled and adjusted at the bench and the whole dropped into the axle differential pot. A new type of universal joint, inside the brake wheel, connects the drive worm to the motor shaft with a demountable armature. The motor is fitted with ball bearings.

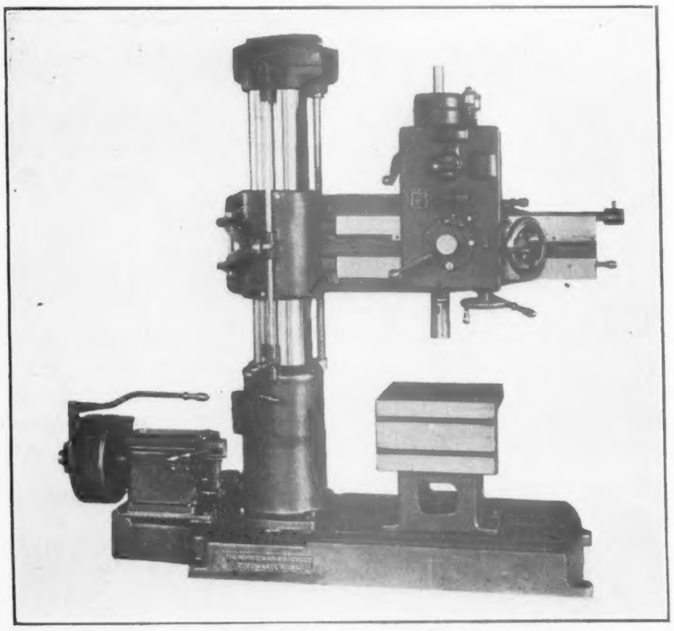
Another feature is the flexibility of the drive unit when traveling over rough surfaces when the platform is loaded unevenly. The tractor platform measures 40 in. by 72 in. and is formed from a single steel plate with deep side flanges. The platform nose is tapered to aid its insertion beneath a skid even though approached from an angle. The lift of the platform is 6½ in. It is 17 in. high when in the lowest position and 23½ in. when raised. Clearances are important when the tractor crosses door-sills, passes over the crest of an incline or a wheel drops into a runway depression. The frame on this tractor is of standard commercial angles and heavy channel sections, hot riveted throughout, and offers possibilities for varying platform lengths.

The low set, all-steel battery compartment at one end is fitted with removable end doors and a hinged cover to facilitate the inspection or quick exchange of the storage batteries. The wire leads between the controller and the battery are continuous—no splices—to the motor brush studs and the motor field coils.

Radial drill provided with a tapping attachment

HIGH speed radial drills in 2-in., 2½-in. and 3-in. sizes, and heavy duty radial drills in 3-in. and 3½-in. sizes have recently been brought out by the Morris Machine Tool Company, Cincinnati, Ohio. The design of all of these machines is basically the same.

The head is fully enclosed and well balanced on the arm so that it travels freely. An adjustable taper gib is provided to take up the wear. One lever operates two clamp screws which securely clamp the head on the arm without affecting the alinement. Oil is properly distributed throughout the head from an oil reservoir at the top of the head by filling an oil cup once a day. The feed worm wheel dips in a trough of oil.



Morris radial drill provided with a tapping attachment and a well designed lubricating system

The spindle is a steel forging which runs in phosphor bronze bearings in the sleeve and is driven by two keyways. It is fitted with ball thrust bearings and the spindle gear is mounted on a ball bearing. The sleeve is of steel, fitted with bronze bearings and the rack is cut directly in the steel sleeve. The helical spindle gears are made of a special alloy steel and are of small diameter, keeping the peripheral speed down to a minimum and thus reducing the possibility of trouble when reversing on high speeds.

The feed gears are enclosed within the head and provide six feeds. These are marked on a dial in .001-in. increments per revolution of the spindle. The feed can be automatically tripped at any depth within the traverse of the spindle. The tapping attachment and back gear bracket is a unit mounted on the back of the head. The friction plates in the tapping attachment are of the multiple disc type. A simple and quick adjustment is provided from the outside of the casing. The tapping capacity in cast iron is up to 2½ in. using a pipe tap. The back gears, back gear clutches and spindle gears are Chrome nickel steel.

A speed chart at the change-speed lever permits the operator to quickly select any one of the 18 spindle speeds. The speed box is of the sliding gear type and is equipped with ball bearings. The gears run in oil and the ball bearings are lubricated by the splash from the gears. The driving pulley is fully enclosed and fitted with a friction clutch operated by a single lever. It runs on ball bearings when the clutch is disengaged.

These machines can be arranged for a constant speed motor drive in connection with the speed box, or a variable speed motor with a 4 to 1 ratio, mounted on the base in place of the speed box and geared to the lower shaft. The variable speed motor may also be mounted on the back of the arm or a constant speed motor and ball bearing speed box, mounted on the arm. This construction eliminates four bevel gears and three spur gears.

The cone drive in connection with a double friction countershaft gives 20 spindle speeds. The countershaft pulleys are 12 in. by 3¼ in. and run at 520 and 600 r.p.m. The column or sleeve which is 9¾ in. in diameter, is mounted on an inner column which extends through to the top and revolves in a ball bearing. The column cap is equipped with an oil reservoir with oil leads to all the bearings.

The arm is designed to resist torsional and lifting strains and the bearing on the column is extra long so that the arm can be clamped in any position by a single lever convenient to the operator. The arm is raised or lowered by a power controller through a lever at the bottom of the column. This lever accomplishes two purposes. First, it automatically unclamps the arm before the elevating or lowering gears are engaged by the movement of the lever. A little further movement of the lever engages the gears and the arm is raised and lowered to its desired posi-

tion. In bringing the lever back to its central position until the latch catches, the gears are disengaged and the arm clamped by one movement of the lever. This is not only a positive safety, preventing the gears from being engaged while the arm is clamped, but it performs the operation three to four times faster than the old method of unclamping the arm before raising and lowering it.

The base is heavy, deep and well ribbed and is provided with T-slots. The oil channel around the base drains through a screen to a large reservoir, having an overflow partition to keep the chips and dirt out of the pump and thus preventing clogging of the lubricating system.

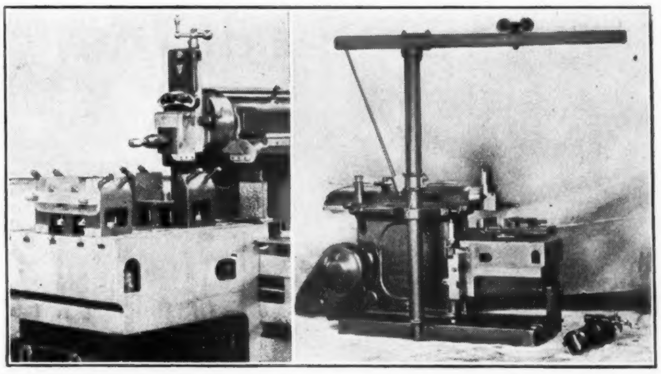
Shaper designed for the railroad shop

A 32-IN. shaper intended principally for railroad work, and arranged particularly for the complete machining of locomotive driving boxes and their accompanying shoes and wedges, driving box crown brasses and rod brasses has recently been placed on the market by the Cincinnati Shaper Company, Cincinnati, Ohio. It is equipped with a special table, extended circular feeding head as well as a standard head, special shoe and wedge chuck, standard vise, and a 1,000-lb. boom crane, and an indexing fixture for planing driving rod brasses. A power-driven rotating fixture for crown brasses can also be supplied, if desired. The machine is arranged either for belt or motor drive.

The special table is arranged with a removable top, 9½ in. deep, which provides a wide range of distances between the ram and the working surface of the table. This top is left in place when planing the crown brass fit in the driving box, as shown at the right in Fig. 1, planing shoes and wedges, or when doing the usual run of shaper work, either with or without the standard vise. It is removed when planing the shoe and wedge fits in the driving boxes, and, when used in this way, provides sufficient height between the table and the ram to permit the largest driving boxes to be placed directly on the table. As can be seen at the left in Fig. 1, mounting the work in this way keeps it directly in line with the outer table support and insures the greatest possible stability for the cut.

The working surface for the upper table is 32 in. by 24 in. and that of the lower table 24¾ in. by 24 in. Both are provided with suitable T-slots and the upper table has holes conveniently located into which stop pins may be inserted. The outer support for the table is effective at all heights whether the removable top is on or off. Also, at no time does any part of it project above the surface of the table in use.

The circular feeding head, as shown at the right, Fig. 1, is used in planing out the crown brass fit in driving boxes and will plane out such fits from a minimum of 8 in. in diameter to a possible maximum of 18 in. in diameter. It is strong and rigid, the extended body being bolted directly onto the end of the ram with four heavy bolts. It may be rotated either by hand or automatically in the same manner as the down feed on the standard shaper. This circular feeding head is furnished in addition to the standard head and interchanges with it on the circular T-slotted end of the ram.



At the left the shaper has the shoe and wedge chuck mounted on the special table—The right view shows the circular feed head removed and the vise mounted on the table

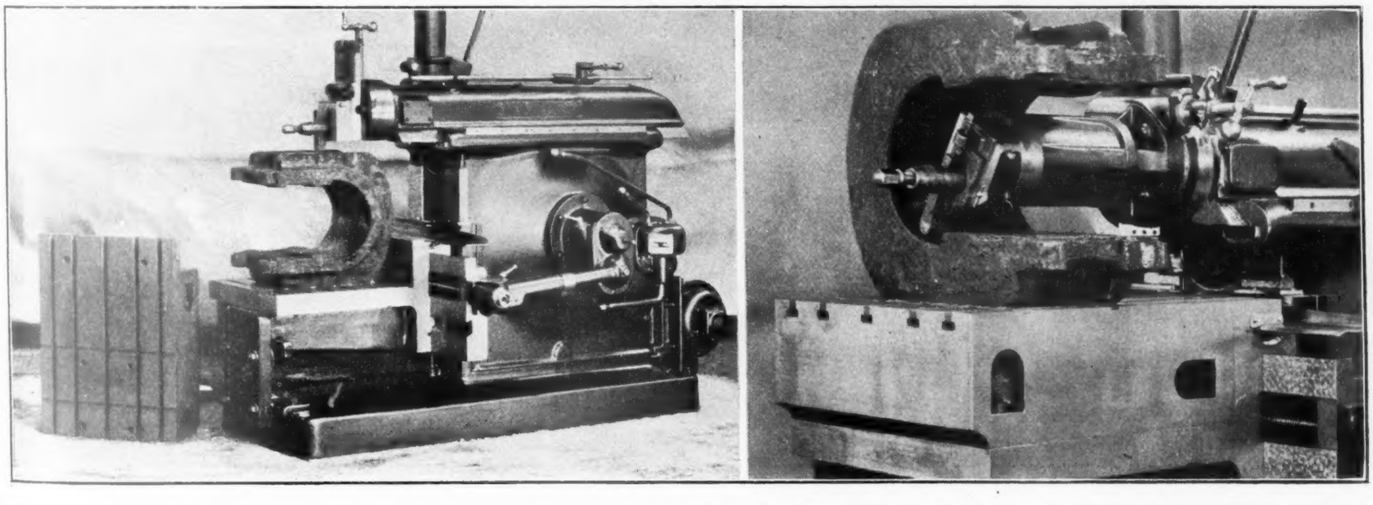


Fig. 1.—**The view at the left shows the shaper set up for machining the shoe and wedge fit of a driving box with the special table on the floor—The right view shows the special table on the shaper with a driving box set up for machining the crown brass**

The special shoe and wedge chuck is arranged to handle both small and large shoes and wedges, and is made in two parts which can be adjusted on the table to suit short or long work. Making the chuck in this way permits the operator to set his surface gage directly on the shaper

table when lining up the lay-out marks or punches. The work rests on four adjusting screws which are conveniently located and very accessible, and which can easily be adjusted to line up the layouts, and is held down by eight screws coming in at an angle from the sides. The front half of the chuck is provided with an end stop bar so that very heavy cuts can be taken.

The boom crane is comparatively light for quick handling, but strong and rigidly constructed with ample capacity for carrying loads up to 1,000 lb.

An unusually strong and heavy vise also is furnished. It is of the double screw type and is of compact design having its working surface but 5 in. above the working surface of the shaper table. The jaws are 3 in. high and 15 in. long, and the vise opens 15 in. An unusual feature of this vise is that but four bolts are used, the same bolts being used for swiveling and for securing the vise to the table. One size wrench only is required for the vise, table support screws, and all the various other clamping nuts which the operator uses for making his settings and adjustments.

The machine is automatically oiled, which provides adequate lubrication to all the moving parts of the machine including the ram ways and rocker arm mechanism. Eight speeds are obtained through the internal transmission which is entirely within the column and runs at all times in a bath of oil. The various feeds are operated by cams which insures smoothness of action. The feeding mechanism is fully enclosed and also operates in oil. The stroke lengths are rapidly and positively set without necessity for starting the machine to determine the length of each stroke.

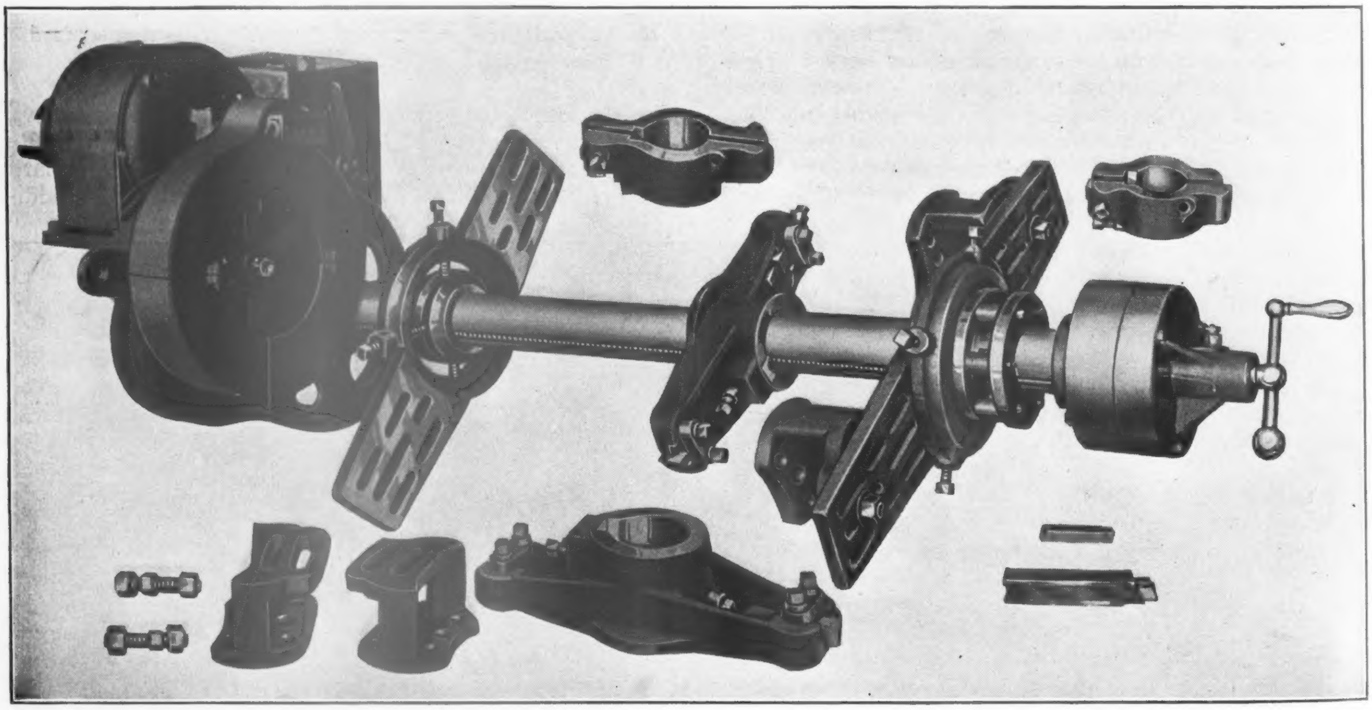
Motor driven cylinder boring bar

MANY locomotive repair shops and engine houses are equipped with motor-driven machine tools. Conforming to this practice, E. J. Rooksby & Co., Philadelphia, Pa., has developed and placed on the market a motor driven portable cylinder and valve chamber boring bar.

The improvement in the design of this machine consists principally in the manner of driving the bar by means of an electric motor. The motor is mounted on a suitable base on the gear drive frame, forming an integral part of it, the speed reduction being accomplished by mechanical gearing. The gear box is provided with four changes of shifting gears which gives the operator a selection of four cutting speeds, suitable for the various diameters of cylinders within the range of the bar. The gears, which have a positive lock shifting device, are completely protected and are enclosed in a gear case and run in grease.

These machines are furnished with either d.c. or a.c. constant speed motors. Should a variable speed d.c. motor be desirable, the speed gear box is not required. The motor may be controlled by an ordinary switch or by an automatic remote control magnetically operated switch, with a start and stop push button station. This latter type is particularly desirable in portable tools as the push button station can be mounted on the gear drive and the switch box placed in a convenient place out of the way of the operator.

The main gear drive is provided with gear guards cast integrally with the frame, adding materially to the strength and safety of the machine as well as affording complete protection to the operator.



The motor forms an integral part of the boring bar for boring out locomotive cylinders and valve chamber bushings

The bars are made of machine steel accurately finished. Long experience has shown that where more than one tool is required to be used at a time, two tools placed on directly opposite sides of the bar produce the best results. Double arm cutterheads have been designed to accomplish this. They are fed along the bar by a totally en-

closed feed box which is automatic and continuous in operation.

The economical and successful operation of any machine tool is very largely governed by a properly designed tool holder and cutting tool. An extra heavy tool holder for use with high-speed steel or Stellite cutters is provided with this machine.

The machines are made in bar sizes of 3 in. to 6 in. in diameter and designed to bore valve chamber bushings or cylinders ranging from 7 in. to 48 in. in diameter.

Machine for reconditioning friction saw blades

THE usual method of sharpening friction saw blades by forming the teeth in the periphery with a hammer and cold chisel seldom resulted in a blade nicked uniformly and to the proper size. The metal is merely displaced by the chisel, thereby widening the rim which increases the power consumption necessary in cutting and also increases the amount of waste on each cut. The rounded mushroom edge results in considerable chipping, and burrs are often left on the work. Blades sometimes fail in service on account of the small cracks or fissures between the teeth, often caused by nicking.

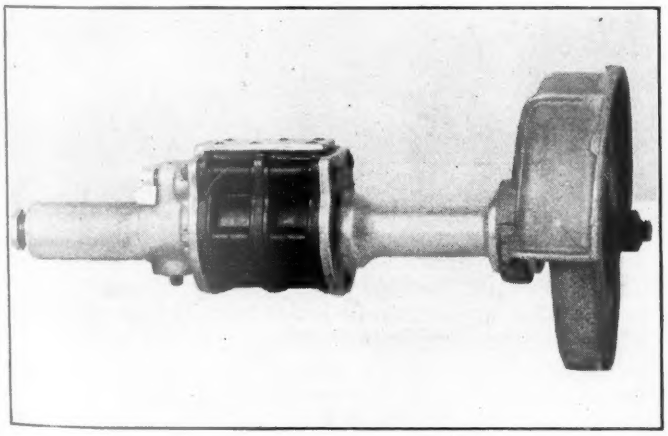
Recognizing these conditions the Joseph T. Ryerson & Son, Inc., Chicago., has developed a machine which sharpens and trims the blades, making them ready for use practically as good as new. The machine consists primarily of a centering and leveling frame, which holds the blade horizontal while a milling and serrating hob applied to the edge of the blade revolves it and at the same time mills the desired grooves, trimming the rim so that the periphery is left true. At another point on the circumference of the blade, a pair of milling cutters removes the slight mushroom effect from both sides of the blade. The hob and milling cutters used, will form teeth in any standard blade regardless of the hardness of the steel.

The work is performed quickly and the teeth cut perfectly according to the specified size and spaced evenly at the proper angle to the radius of the blade, so that they have all the strength and resistance of a new blade. The ease of operation of the machine makes it possible for a comparatively unskilled workman to use it.

Friction saw blade sharpener which mills and trims the blade in one operation

Pneumatic grinders driven by rotor principle

A LINE of pneumatic grinders which operate through the usual air line supply, but differing from the recognized types in that they use a rotor mounted on the drive shaft with the valve mechanism, controlled by a sliding valve, instead of pistons, has been developed by the Warner & Swasey Company, Cleveland, Ohio. This design confines the work to three parts.



Grinding machine which has only three moving parts

The method of rotation is as follows: Air enters through the air inlet; a small portion of it being conducted upward to the air cushion chamber and then deflected downward, exerting a constant pressure on the upper edge of the valve blade. This pressure maintains a sealing effect between the eccentric surface of the rotor and the valve blade, no matter what position the grinder is in. The main portion of the air entering the air inlet rushes in the cylinder causing rotation of the rotor in a clockwise direction. When the rotor has revolved about three-fourths of its cycle, the air moves upward to the exhaust chamber, and is exhausted through the ports. The two rotors which rotate in their respective cylinders are mounted directly opposite on the shaft so as to give a balanced effect, and overlapping power strokes. This gives a steady flow of power with a motion that is noticeable for its lack of vibration.

The three moving parts consist of the shaft assembly to which the two rotors are fastened by means of keys, all of which are made from Chrome Nickel steel. The two valve blades are made of a special light material which reduces momentum due to reciprocation.

Parts subject to wear have been reduced to a minimum. Disregarding ball bearing friction between the shaft and the two ball bearings on which the shaft is mounted there are but two points of friction contact. These are the points of contact of the two valve blades as they rise and fall on the eccentric surface of their respective rotors. The blades are made of a special fibre material, but since they are in contact with steel surfaces they must absorb such wear as occurs. When it is necessary to replace these blades, a screw driver is the only tool necessary. The cap is removed at the top of the grinder cylinders,

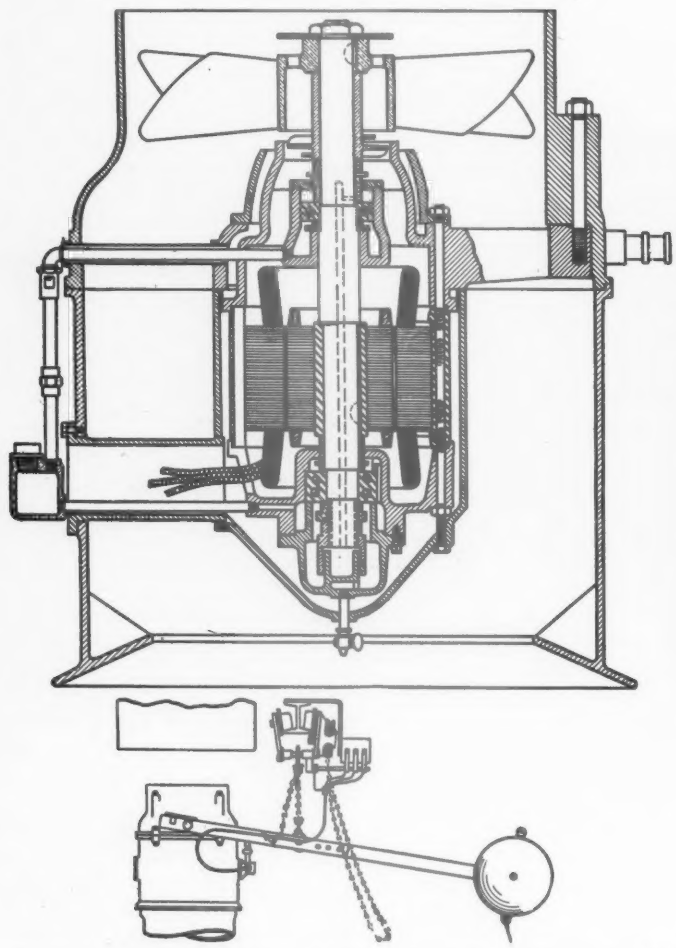
the new blades are inserted, the cap replaced and the grinder is ready for service.

There is no friction contact between the surface of the rotors and the cylinder walls. Ample clearance of from .002 to .003 in. is provided. The constant oil film present seals this clearance, preventing any air leakage past the rotor surface. An oil reservoir in the air inlet holds an ample supply of oil for the average day's run. This oil is fed into the cylinders in the form of a mist, and is easily adjusted by means of a needle valve. The grinders will operate efficiently at air pressures varying from 65 to 90 lb. with an air consumption of from 32 to 40 cu. ft. per min.

The machine is made in three sizes. The Type D-2 size is for general grinding with a free speed of 4,500 r.p.m. and weighs 15 lb.; the Type D-2-X size is for high speed buffing and polishing with a free speed of 6,000 r.p.m. and weighs 15 lb.; and the Type D-1 size is for the light grinding work with working speeds of 3,500 to 7,000 r.p.m. and weighs 8¼ lb.

Blower for drafting locomotives in enginehouse

EVERY time the steam pressure in a locomotive is let down, it is necessary to draft it in the enginehouse so that it can pull out under its own power. The present method of drafting a locomotive is to connect the engine steam line to a steam jet blower located at the bottom of the stack. The Coppus Engineering Corporation, Worcester, Mass., has designed and placed on the market an electric operated blower known as the Locoblow which is a redesign of the blower of the same type which was first introduced to the railroad field in 1923.



Cross-sectional view showing arrangement of the motor and fan

The motor of the blower is essentially the same in capacity and design as that of the earlier type and the whole unit is similarly suspended from an I-beam monorail. The new blower, however, is more compact and lighter in weight and is much easier to handle from the enginehouse floor due to a balancing feature which makes it possible to raise the machine through the entire range of lift by a light pull on a rope attached to the end of a counterbalance. It may then be rolled over the stack by means of pulling the endless chain in the desired direction and lowered down upon the stack by releasing the rope. Current from the switch is led to three contact rails and is then carried to the motor through sliding copper contactors.

As some trouble was experienced with the earlier blower due to the lack of lubrication this feature has been given special attention in the design of the Locoblow as will be seen by referring to the cross-sectional drawing. Oil is poured into the reservoir shown to the left until it overflows. This submerges the lower ball bearing and the oil-filling chamber below this bearing. When the blower is in operation the screw thread shown at the lower end of the rotating element pumps the oil through the hollow shaft to an outlet over both bearings. The oil which passes over the top bearing enters a reservoir immediately below from whence it is returned into the oil chamber by way of suitable piping.

Motor driven locomotive blower which can be placed over the stack or swung out of the way by an endless chain

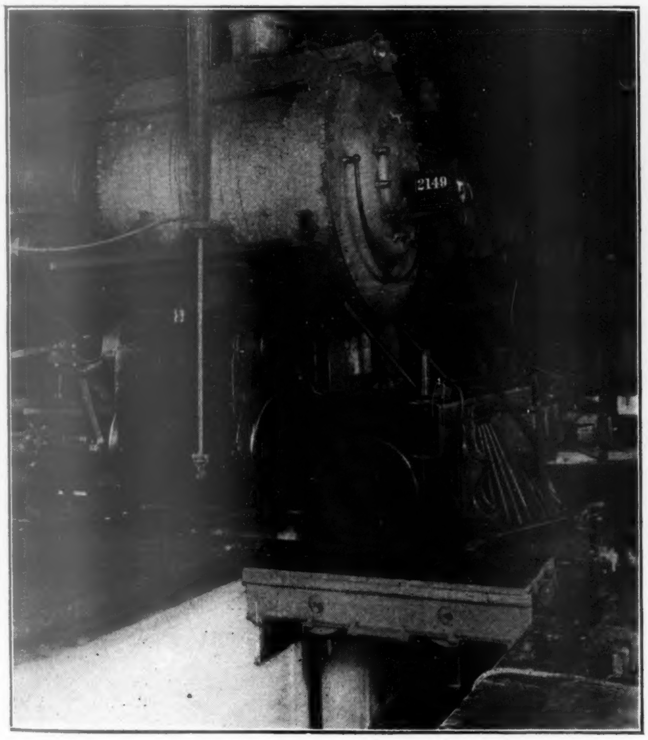
As the motor is suspended in the center of the blower in such a way that the gases must pass around it, special attention has been paid to ventilation. The motor is encased and a strong current of air passes between the outside of the motor and this casing, this current being in-

duced by the action of the main fan. Just below the main fan is located a smaller fan through the hub of the main fan and the air which goes between the motor and casing surrounding the motor is discharged over the hub of the fan so that no great quantity of heat is transmitted to the shaft. The lead wires to the motor pass through one of the two tubes connecting the casing which encloses the motor with the fan casing proper. Care has been taken that none of the motor parts comes in contact with the hot gases or metal parts heated by the gases.

The advantages claimed for this device are that it can be operated with much less noise and dirt; a more constant draft is induced due to being less subject to line fluctuations; the cost of firing up a locomotive is reduced and the work is done in much less time. It has been thoroughly tested in an enginehouse under normal conditions which tests showed a saving of 15½ min. to get up 65 lb. steam pressure from cold water. A saving of 92½ per cent in the cost of firing up a locomotive was shown by the tests.

Whiting screw-type electric drop table

THE screw-type electric drop table shown in the illustrations may be designed to perform any dropping operation on locomotives or cars. In dropping locomotive drivers, it is not necessary to take the locomotive weight on the jacks before starting as the table has a capacity of 50 tons. Neither is it necessary to spot the locomotive closely as the entire rail section drops. As there are no heavy rail beams to be moved out of the way, only a mechanic and helper are needed to do the work. In replacing the drivers with a drop pit, they are first replaced, the rail beams moved in place and the scaffold erected. With the drop table, the operator can stand in the table pit and come up with the drivers. The shoes can be placed first and held by shims. The pedestal binders may be set on blocks and fitted with wedges. In this way all the operations can be performed at once, thus saving considerable time.

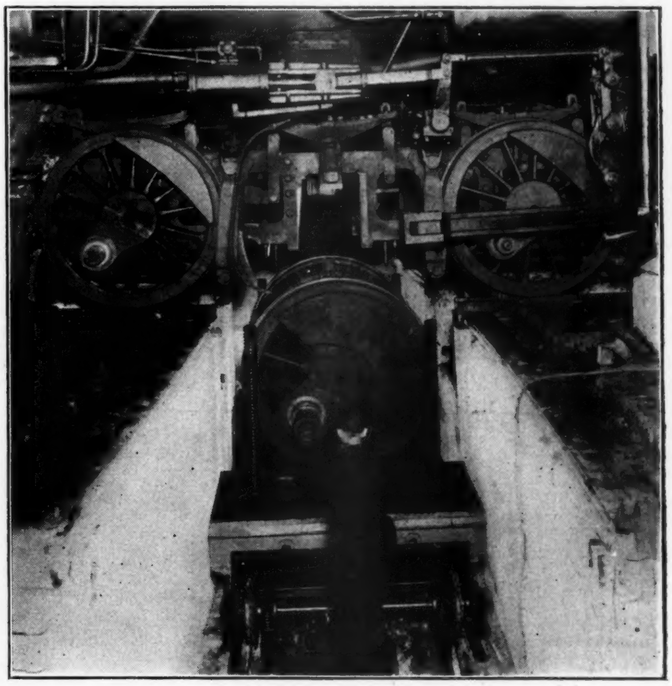


Truck wheels on the table ready to be dropped

If of sufficient length, a complete four-wheel engine or tender truck can be dropped in a single operation. On the other hand, a single pair of tender wheels can be removed by running them out on the table and blocking under the spring seat. If there is a cradle casting on the trailer, it can be blocked on the table and dropped without using extra blocks and tackle.

Boosters are readily removed on the drop table. This is a very difficult operation on a drop pit jack on account of the shifting weight, due to the overhanging weight of the booster engine and the spring weight, which drops to zero after a few inches. As the drop table has four legs any shifting of weight does not affect it.

Spring work can be done quickly and easily without disturbing any box packing. To renew a spring, the table is raised 2 in. above the rail and the spring rigging blocked. The table is then dropped, relieving the weight off the spring. It can then be readily renewed. The same method can be employed in spring equalization.



The main driving wheels of a Mikado removed and lowered to the bottom of the pit on the drop pit table

The drop table consists essentially of a truck with four stationary screws, the table being built on top. Wheels and axles are provided at each end of the truck, being inserted in roller bearings to permit easy lateral movement. The boxes are spring supported so that, when the full locomotive weight is received, the springs will deflect. This in turn seats the screws on the rail, passing the weight directly onto the foundation.

The table rails are reinforced and supported by beams, the load being carried by means of transverse channels to the driving units, which consist of screws and worm wheels with roller thrust bearings. The latter are 14 in.

in diameter and contain 56 rollers. The driving motor is mounted on the table. The control is a matter of choice, the push button types with extension cord being the most flexible.

The pit is rectangular in cross section and may be constructed straight or in conformity with the enginehouse circle. Channels are set in the wall to guide the table and to insure its being correctly positioned. Sockets are provided for the power plug. Only ordinary drainage is required, as there is nothing of a hydraulic nature about the drop table.

As the locomotive is run onto the table, the live load is taken on the locking bars, situated just under the table rail. The power is then turned on and the table run up until the weight is relieved from the locking bars. These bars are then thrown out, a single lever performing the operation. The table and load are then dropped to the low position. The table is then moved laterally by ratchets and after being moved laterally is again raised to the surface. The reverse movement is made likewise.

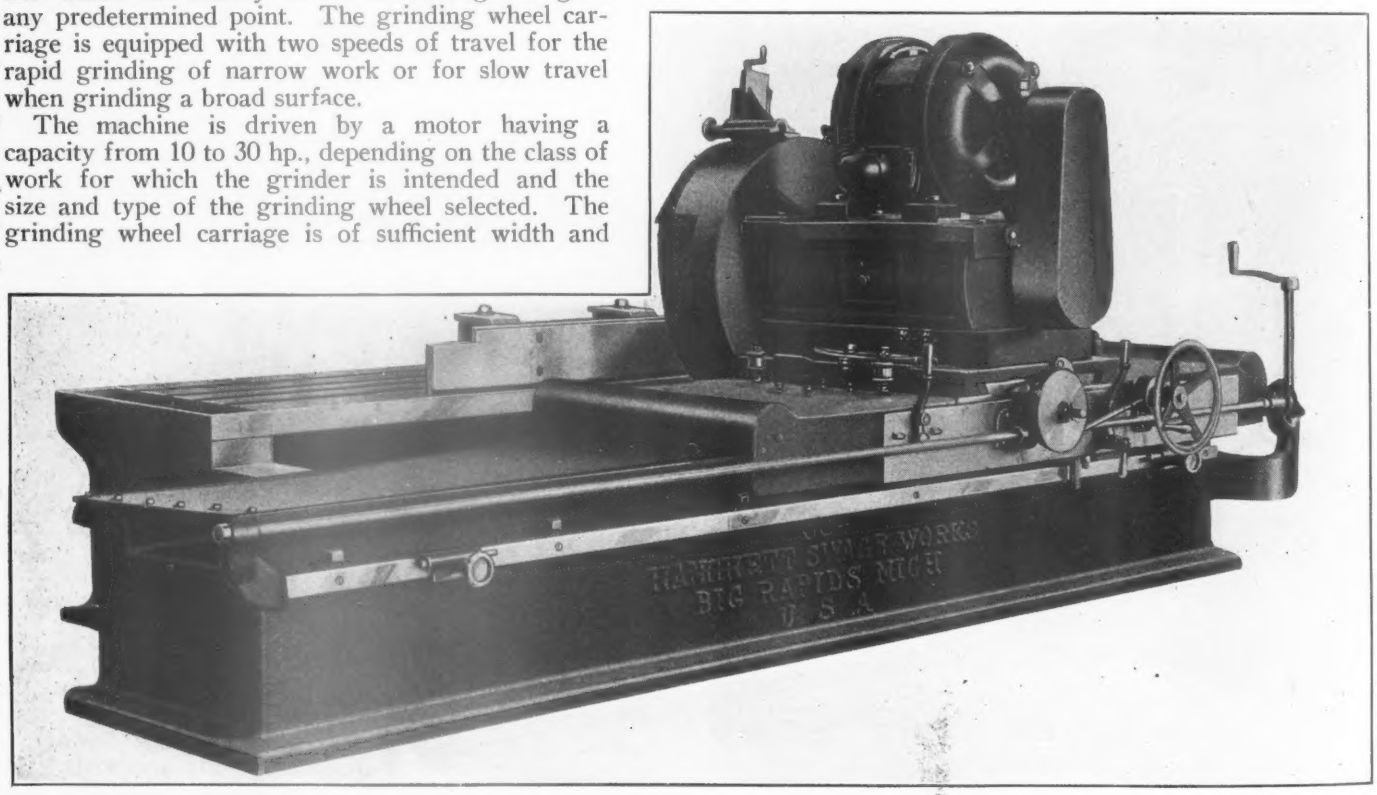
The minimum table length is about 6 ft. 8 in. and the maximum is somewhat indefinite, being controlled by practical considerations. A 10-ft. 6-in. table is capable of handling practically everything. The minimum net table thickness for an integral table is about 2 ft. 1 in. This added to the required drop gives the pit depth. Thus a drop of 6 ft. would require a pit depth of 8 ft. 1 in. The overall width varies with different designs. This equipment is manufactured by the Whiting Corporation, Harvey, Ill.

Cabinet base traveling wheel grinder

THE grinding machine shown in the illustration has a capacity for handling locomotive guide bars, knives, shear blades and general surfacing. The machine is fully automatic, adjustable for any speed of grinding and to feed the grinding wheel to the work at any speed desired, with an automatic stop and graduated dial which can readily be set to cease grinding at any predetermined point. The grinding wheel carriage is equipped with two speeds of travel for the rapid grinding of narrow work or for slow travel when grinding a broad surface.

The machine is driven by a motor having a capacity from 10 to 30 hp., depending on the class of work for which the grinder is intended and the size and type of the grinding wheel selected. The grinding wheel carriage is of sufficient width and length to prevent vibration and is operated by a silent chain and gear drive from the motor arbor, through steel gears completely enclosed in the base of the carriage and running in oil. The pump for the cooling solution is driven by a belt from the grinding wheel arbor and is held in position by sliding ways which are adjustable by a hand wheel to keep the belt at the proper tension.

The machine is equipped with a knife bar for ordinary knife grinding with a magnetic chuck, a flat platen for holding various classes of work and with revolving work holders on which one setting of the work up to full capacity of the machine—in units up to approximately half of the machine capacity—can be placed in position while another setting is being ground, thus keeping the machine in nearly continuous operation without the usual intervals for putting on and taking off work while the machine is idle. A knife bar supplied with two faces with different lengthwise or crosswise slots adapts the one bar for a variety of work. It is adjustable by a worm and gear to hold the work at any desired angle or in a vertical or horizontal plane, and when set can be locked in position. The machine is equipped with a wooden shelf or loading table level with the knife bar on which knives or shear blades can be loaded and then moved over to the bar without danger of injury of loading directly onto the iron bar. The grinding wheel carriage, in addition to the automatic feed



Grinding machine which will handle locomotive guide bars

to the work, can be rapidly withdrawn from the knife bar by a large hand wheel control to facilitate putting on or taking off work. The machine illustrated has a capacity of 84 in. and weighs approximately 11,000 lb. crated.

This machine is manufactured by the Machinery Company of America, Big Rapids, Mich.

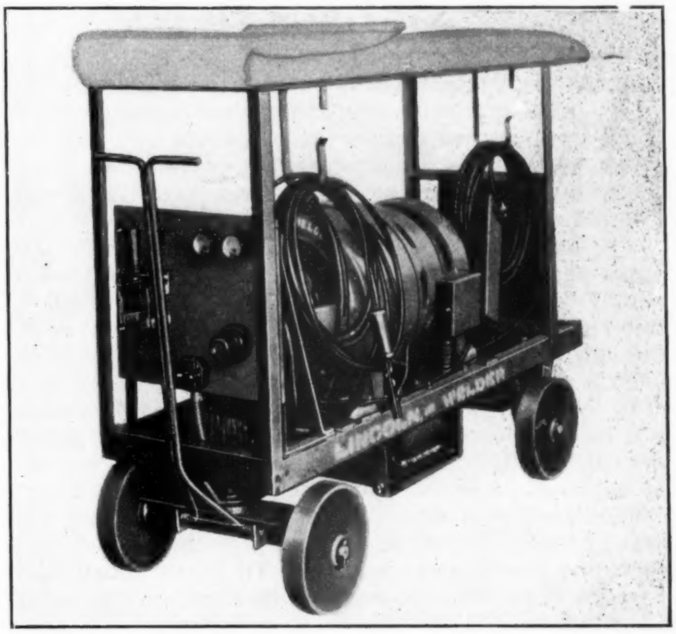
Electric welder designed for railroad shops

AN electric welder especially designed for use in railroad shops has been placed on the market by the Lincoln Electric Company, Cleveland, Ohio. The equipment is said to afford unusual ease of operation and to be especially well adapted to its particular field because of its relatively narrow width. It is 21 in. wide so that it will easily pass through the narrowest aisles in a shop. It is fully equipped with large roller bearings which add to its ease of mobility.

The center of gravity of the machine is low so that it will not be liable to tip over. The frame is of structural steel, extending beyond the equipment on the truck, so that it is almost impossible to back the truck into anything which would damage the welder. This is a desirable feature owing to the rough handling equipment of this nature receives in the railroad shop.

The welder, which is a 300-amp. arc unit, uses the stable arc. This arc will weld such jobs as locomotive frames, crosshead guides, truck sides, main driving wheels, journal boxes, etc. It is said that in actual tests, from four to five feet of fire-box seam has been welded in an hour; and that from seven to ten pounds of metal has been placed on a crosshead guide in one hour.

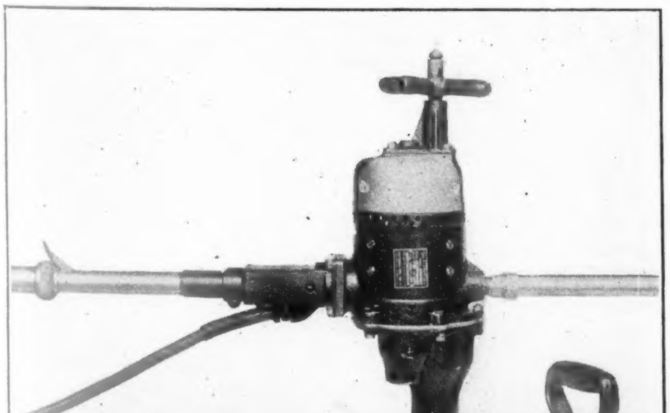
The machine is provided with water-proof covers, which can be thrown back easily and which, when dropped down, provide complete protection from the weather. A push button starter, tool box, handy but out of the way, a spring controlled handle which is out of the way when not in use, convenient cable hooks, and light total weight are some of the other features of this equipment.



Portable electric welder which can readily pass through the congested shop owing to its restricted width

An electric drill and reamer for the car shop

A DIRECT current, compound electric drill and reamer for use in car repair work has recently been placed on the market by the Independent Pneumatic Tool Company, Chicago. It has a drilling capacity up to 1¼ in. and is especially suited for reaming 13/16 in. and 15/16 in. holes in steel car construction work. It has a maximum speed of 600 r.p.m. and weighs 60 lb.



Thor motor driven drill and reamer adaptable for car construction work

Its construction has several features which lend to its adaptability for the work for which it is intended. The one-piece bridge and housing construction of the rear end of the machine provides easy accessibility and also carries the upper armature bearing in permanent alinement with the lower one. The motor is air-cooled through vents in the starter housing. These vents are not drilled radially, but are at a tangent to the fan blade's motion. The rectangular brushes are provided with a liberal area for the maximum of current they carry. The holder, which embraces the brush, draws the heat rapidly away from the commutator surface and spreads it throughout the brush assembly. The radiation, accelerated by the increased air current of the angular vents, carries off the heat from the brushes.

To secure as nearly a perfect balance as possible, first the commutator and fan and then the complete armature are balanced separately so as to eliminate vibration. The commutator is not attached direct to the steel armature shaft because steel does not expand the same under heat as copper. The commutator is a separate unit, built up on a brass sleeve that expands and contracts evenly with the copper segments. Rectangular slots are used on the motor armature which allows the use of more wire and insu-

lation which permits the usage of double silk-covered wires for the coils.

The gears in the motor are machine cut from alloy steel. The roller bearing assembly on the center plate stud provides support for the upper end of the spindle which eliminates strain and wear on the plain bronze spindle bearing at the lower end. The machine is equipped throughout with ball and roller bearings.

The tool is provided with a side handle switch which eliminates all wire connections between the switch handle and the motor. It is a separate unit and makes contact from the motor to the line by means of brass plungers. The cable is of the three-conductor type and leads into the handle through a supporting taper coil spring. A plunger type of switch is used which is located in the handle for the convenience of the operator.

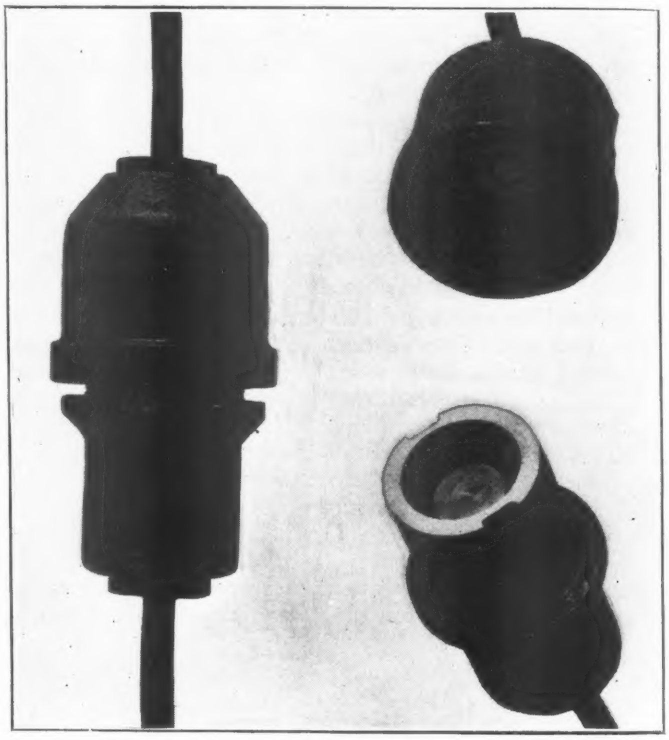
Armored weather-proof connector

A WEATHER proof connector which is intended to make it possible to instantly connect and disconnect with the line without the use of tape or tools, motor driven portable welders or other portable machines has recently been developed by the Ohio Electric & Controller Company, Cleveland, Ohio.

The socket end of the connector should always form the upper part so that any water which may fall on it will be readily drained off and not enter the connector. Asphaltum compound is filled in around the cable where it goes through the insulator so that no water can enter at this point.

In the lower or socket end of the connector, the contact is a loose fit in the insulator and is supported by a compression spring, current being carried around the spring by means of six flexible conductors. This flexible support is to insure a solid electrical contact between the upper and lower halves. When the two parts of the connector are open, the live contacts are protected by the skirt of the armored shell which extends an inch beyond the contact points.

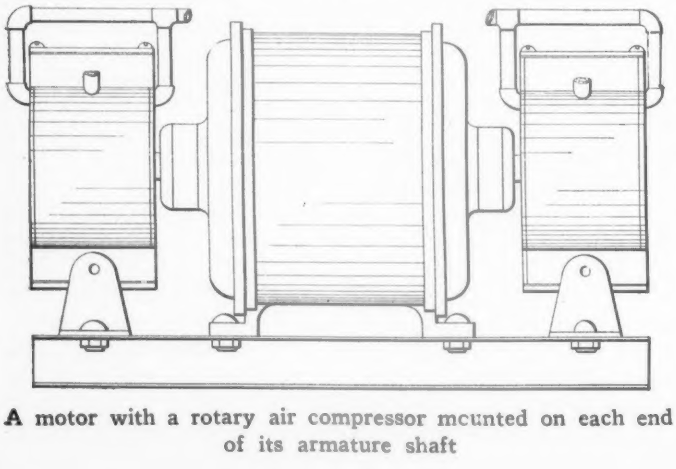
A short piece of No. 4 B. & S. flexible cable is soldered to each end of the connector and, for a short time this cable is capable of carrying 1,000 or 1,200 amperes. The continuous capacity of the connector is 150 amp. which it can carry under test with a rise of 10 deg. C. Intermittent capacity such as would be encountered by a crane motor is 300 amp. It is made only in one size, weighs 3½ lb. and can be furnished as a two or three pole connector when desired.



Weather-proof connector adaptable for motor driven portable machines and cranes

Valveless high speed synchronous air compressor

THE rotary compressor shown in the illustrations is intended for use in pumping fluids or compressing air. Compactness and simplicity of construction are its outstanding features. The ordinary inlet and outlet valves are not used in this machine. An unusual feature is the arrangement of the outlet ports which function as a check valve when they do not register or when the fluid or air is not being discharged from the machine. The operation of the compressor is practically noiseless and for many purposes operative without an air receiver. It is generally motor-driven and unloading devices are unnecessary. An unusual feature is the absence of fly-wheels, pulleys, crankshafts, etc. The rotors function as fly wheels and being located in the casing also function with the casing as suction and discharge valves.

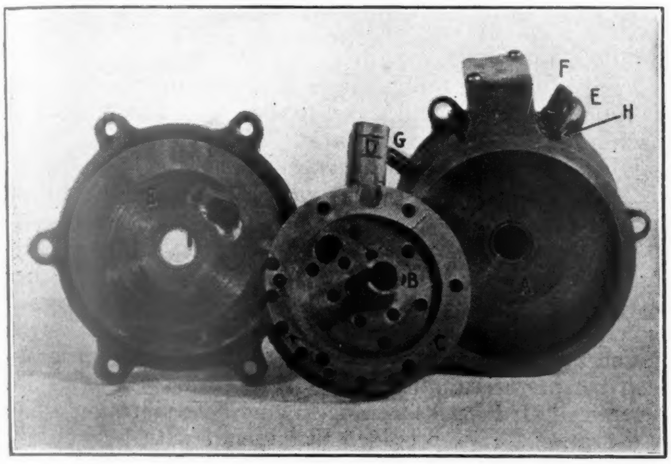


A motor with a rotary air compressor mounted on each end of its armature shaft

The machine was developed by John Milne, 273 Greenwich St., New York. It consists of a cylinder divided into two equal parts by a hollow partition, one face of which is shown at *A*, thereby forming two separate compression chambers. In each of these chambers there is a compressor which is made up of an eccentric or piston *B*, a ring *C* and the sliding partition *D*. The chambers are enclosed between covers *EE*. These compressors are arranged to balance each other, and one may act independently of the other, one being used for compression purposes and the

other for producing a vacuum. The compressed air or fluid from one chamber may be stepped up in the other to any pressure within the limits of compressor practice. One of these double compressors may be mounted on each end of the shaft of one motor, and thus four machines would be compressing at 90 deg. apart. The four units may also be arranged to perform separate functions if desired, two used for air and two for fluid, etc.

In the partition dividing the two chambers of the one machine, there is a cavity in which water or other cooling



Partially disassembled machine showing the piston ring assembled on its piston and the sliding partition *D* mounted in the piston ring

medium is circulated through the pipe shown at *F* and *G*. The shaft of the driving motor enters the bore of piston *B* and is keyed to it. The capacity of the machine is rated as ranging from 1/4 cu. ft. to 10,000 cu. ft. and for operation at speeds from 350 to 3,600 r.p.m. for various pressures.

In operation, the rotation of the eccentric piston *B* produces motion of the ring *C* of a combined rotary and reciprocating nature. As the eccentric throws the ring to its maximum position off center, the ring presents the maximum opening between its periphery and the cylinder wall on the right-hand side of the sliding partition. On this side of the partition the cylinder wall carries the intake port *H*. When the rotation continues, the throw of the eccentric carries the ring around in such a manner as gradually to move the widest opening between the ring periphery and the cylinder wall clockwise, until the air or liquid is compressed against the other side of the sliding partition *D*, at which time the port in the eccentric registers with the port in the ring, giving clear outlet to the compressed air or fluid.

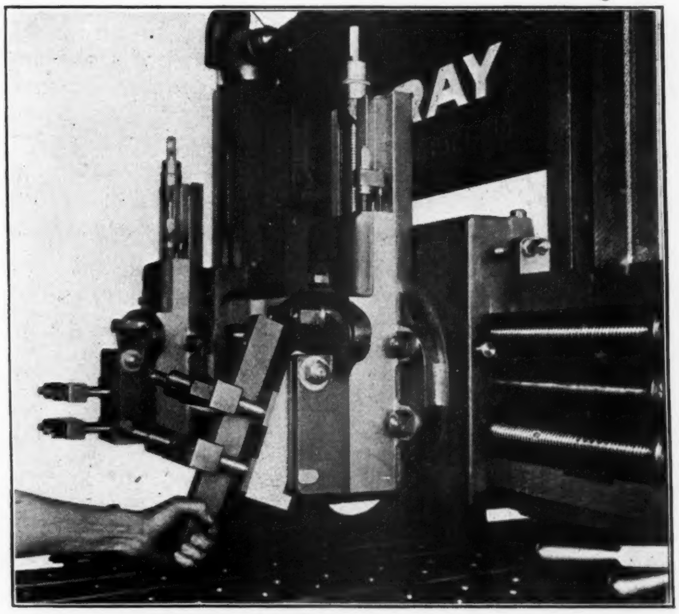
The sliding partition has a three-quarter cylindrical bearing in the edge of the ring. As the ring is moved it oscillates in this cylindrical type bearing or hinge and also in its change of position it slides the partition up and down in ways located in the boss on the top of the cylinder. Thus there is always a sealed division between the intake and outlet ports. The numerous small holes shown on the face of the piston and ring are intended to reduce the weight of those parts. The outlet ports in the ring, the piston and the cover register with each other at a predetermined point in each revolution of the piston and ring, and the compressed air or fluid is discharged through these alined or coacting ports at a predetermined point into the outlet in the cover.

The sliding partition *D* serves only to seal the outlet compartment from the inlet portion of the cylinder. When the outlet ports in the piston ring, piston and cover are not in line, they function as a check valve for the air or fluid in the cylinder and the air or fluid in the outlet piping.

Abutment type apron for Gray planers

The accompanying illustration shows the abutment type apron which is a recent improvement of the Gray planers manufactured by the G. A. Gray Company, Cincinnati, Ohio. This apron consists of a heavy supporting rib running across the bottom of the apron. When the apron drops back in the toolbox, this abutment bears in a finished shoulder on the bottom of the toolbox, so that the tremendous upward thrust of the tool, when taking heavy cuts, comes on this abutment rather than on the taper pin from which the apron is suspended. This was designed not only to protect the taper pin against excessive wear, but to avoid breakage of the pin or the tool box in case of an accident. Another advantage claimed for it is the fact that it materially stiffens the apron against the tendency to curl up when a heavy clamping pressure is used on the tool clamping bolts.

The head and saddle have also been modified by the application of the twin-purpose taper gib, which is so called because it is used for the dual purpose of taking up for wear and also for clamping the sliding parts rigidly to the stationary parts. The head of the gib is held in place by two shoulders on the clamping screw. This screw has a squared end, so that the operator can apply the usual crank to this screw and with a partial turn force the gib lengthwise between the slide and the harp, thereby wedging it tight over its entire length. Because of the slight angle of the taper gib and the fine pitch of the screw, a considerable clamping pressure can be obtained by only a slight pull on the crank handle. To unclamp, the clamping screw is turned in the opposite direction until the head of the gib is pulled firmly against the cheese-



The abutment type apron permits the taking of heavy cuts

head cap screw which limits the upward travel of the gib. This brings the gib back quickly to the running position. As the parts wear the cheese-head cap screw is easily adjusted to change the running position of the gib to compensate for this wear. In cases where the operator wishes to tighten the slide merely enough to take up any tendency to move up and down while cutting, he can easily get the desired adjustment by a partial clamping of the gib. In this application the taper gib is used on a dovetail surface, but the same idea is applicable to ordinary conditions.

Portable electric circular wood saw

A PORTABLE electric circular saw adaptable to trimming car flooring and roofing and suitable for general use about a car shop or repair yard, has recently been developed by the Crowe Manufacturing Corporation, Cincinnati, Ohio.

An electric hand saw for the car man

The body of the tool is made of aluminum which makes it light in weight and easy to handle. Every part is machined and is interchangeable. The smaller size, which weighs 15 lb., has a cutting capacity, with an 8-in. blade, of 2½ in. and the larger size, which weighs 25 lb., with a 12 in. blade, will cut material 4½ in. thick.

The motor used is of the universal type, especially designed for this kind of tool. It can be supplied for either 110 or 220 volts. The saw is equipped with a trigger switch, the purpose of which is to insure safety, as the operator's finger must be held on the switch in order to keep the motor running. The motor fan and shafts are dynamically balanced in order to eliminate vibration while in operation. It is provided throughout with heavy duty ball bearings.

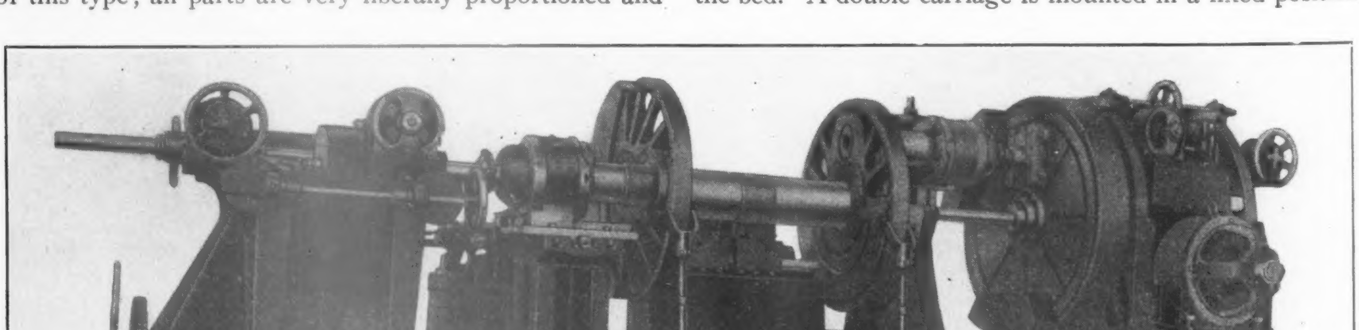
In operation, the front guide is rested flatly on the material to be cut before starting the motor. It is always advisable to keep the cutter away from the material until after the motor is started, then the saw blade is fed into the material, always keeping the finger on the trigger. After the cut is completed, the trigger is released and the tool removed for a new cut.

It is furnished with an electric light extension cord fitted with a plug which fits in any standard light socket.

Journal turning and quartering machine

THE journal turning lathe illustrated has been placed on the market by the Putnam Machine Works of Manning, Maxwell & Moore, Inc., New York, to handle wheel sets up to 86 in. in diameter on the thread. This lathe amply meets all the requirements of a machine of this type; all parts are very liberally proportioned and the various units are particularly convenient of operation.

The drive to the main spindle is by a hardened and ground worm supported on ball bearings, the worm driving a bronze worm wheel mounted directly on the spindle. Both the headstock and the tailstock are adjustable along the bed. A double carriage is mounted in a fixed position



Putnam 90-in. journal turning, quartering and crank pin turning machine, showing the crank pin turning attachment in position

for use on driver sets and a single carriage, arranged so that it may be swung around out of the way, is provided for use on trailer sets.

A faceplate of special construction is mounted on the forward end of the main spindle. The opening in the faceplate is 12 in. in diameter and of sufficient depth to accommodate the largest trailer axles. A pear shaped opening is provided into which the crank pins enter. Two independently adjustable counterweights are fitted to the face of the faceplate, each being provided with a pinion meshing with a gear ring set into the faceplate; adjustment being made by a ratchet wrench placed on the squared end of the pinion shafts. The counterweights are so arranged that any driving wheel set may be balanced and also the counterweights may be placed in balance while turning the trailer journals.

Both head and tailstocks are clamped by two large bolts on the front and two on the back, which engage T-slots in the bed. The bolts are set up by two wedges, actuated by a right and left hand screw, thus equalizing the strain on each bolt. The device is operated from either side of lathe by a ratchet wrench and quickly clamps both the head and the tailstock firmly to the bed. The adjustable spindle in the tailstock carries a ball bearing center, the headstock spindle having a live center. Therefore, no rotation takes place on the machine centers in the center holes of the axles.

The machine can be arranged for either single or double quartering with a capacity for quartering wheels of locomotives with 22 in. to 36 in. stroke.

The crank pin turning attachments are of the sleeve type, the tool slide being mounted on the end of a sleeve which completely surrounds the crank pin and revolves in a large bronze bushed bearing, thus providing rigid support for the tool. Either single or double crank pin turning attachments can be supplied if desired and can be readily removed from the machine when not in use.

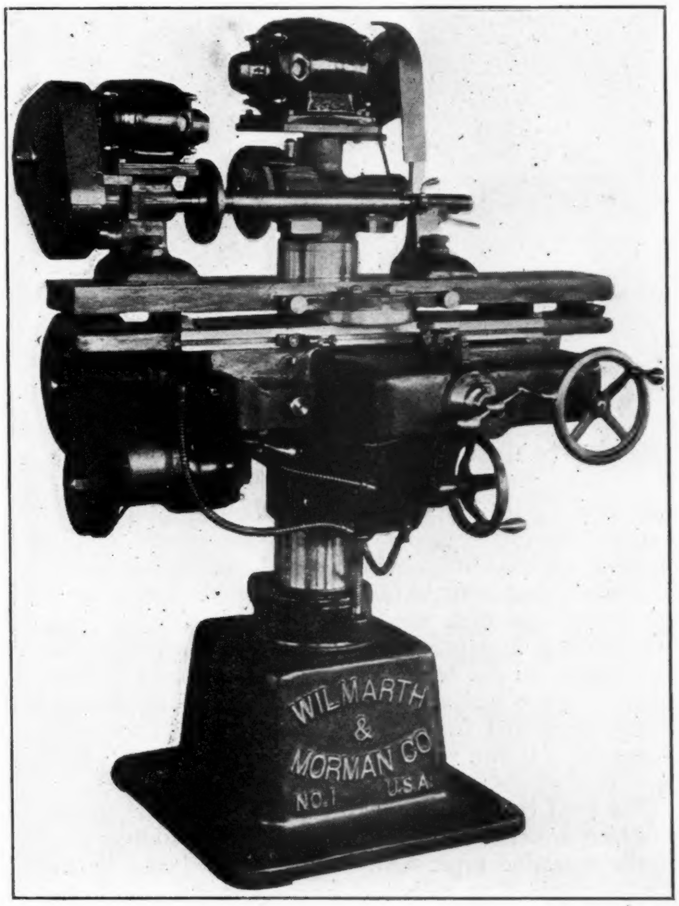
The drive can be either by a 15 hp., constant speed motor, or a 15 hp. adjustable speed direct current motor. The faceplate speeds are from 12 to 36 r.p.m. The longitudinal and cross feeds are 1/32 in., 1/16 in. and 1/8 in. for traversing the headstock and tailstock, two 5 hp., reversing, constant speed motors are required, one mounted inside the bed at each end and geared direct to the traversing screws. The quartering attachments are driven by 3 hp. motors.

Universal cutter and tool grinder

A UNIVERSAL cutter and tool grinder suitable for service in the tool room of a railroad shop has recently been placed on the market by the Wilmarth & Morman Company, Grand Rapids, Mich. The machine is motor driven and is designed for such work as facing milling cutters, grinding the blades of taper reamers, grinding cutters, hobs, etc., face and cylindrical grinding and is also provided with an attachment for internal grinding. Spindle extensions are furnished with the machine which makes it convenient to do surface grinding within the capacity of the machine.

It is mounted on a base 24 in. square, which is of sufficiently massive construction so that when the table is at its extreme position, there is no tendency for the machine to tip. The column is so mounted as to become an integral part of the base. It is ground to provide a smooth bearing for the rotation of the outer column or sleeve. The main spindle housing is carried on the top of the column which is also mounted as an integral part. Referring to the illustration, the sleeve or cutter column revolves around the inner column carrying the knee with its elevating screw. After being rotated to the desired position, it is locked by a clamp screw at the base, which draws two wedges together and against the inner column. The faces of these wedges are machined to fit the base of the column so that there is no tendency to score or wear it.

The knee is of unique construction. It has a solid top with a vertical cylindrical section which takes its bearings on the ground surface of the outer column or sleeve. To insure that the knee rises perpendicularly, a large key is mounted in the face of the sleeve and the keyway is planed in the knee. The keyway is provided with a take-up gib so that it can be tightened if wear ever causes any looseness. A dust protecting ring makes it impossible for any dust to reach the surface. The saddle carries a web or flange, 4 in. deep all the way round. This design, not only adds strength and rigidity, but aids in eliminating dust and grit from the mechanism. The saddle takes a bearing over the full top of the knee at all times and this bearing is provided with an adjustable gib. The saddle



A universal cutter and tool grinder provided with front and rear controls

bearing for the sub-table is 28 in. long and is provided with a taper take-up gib so that it is easy to maintain.

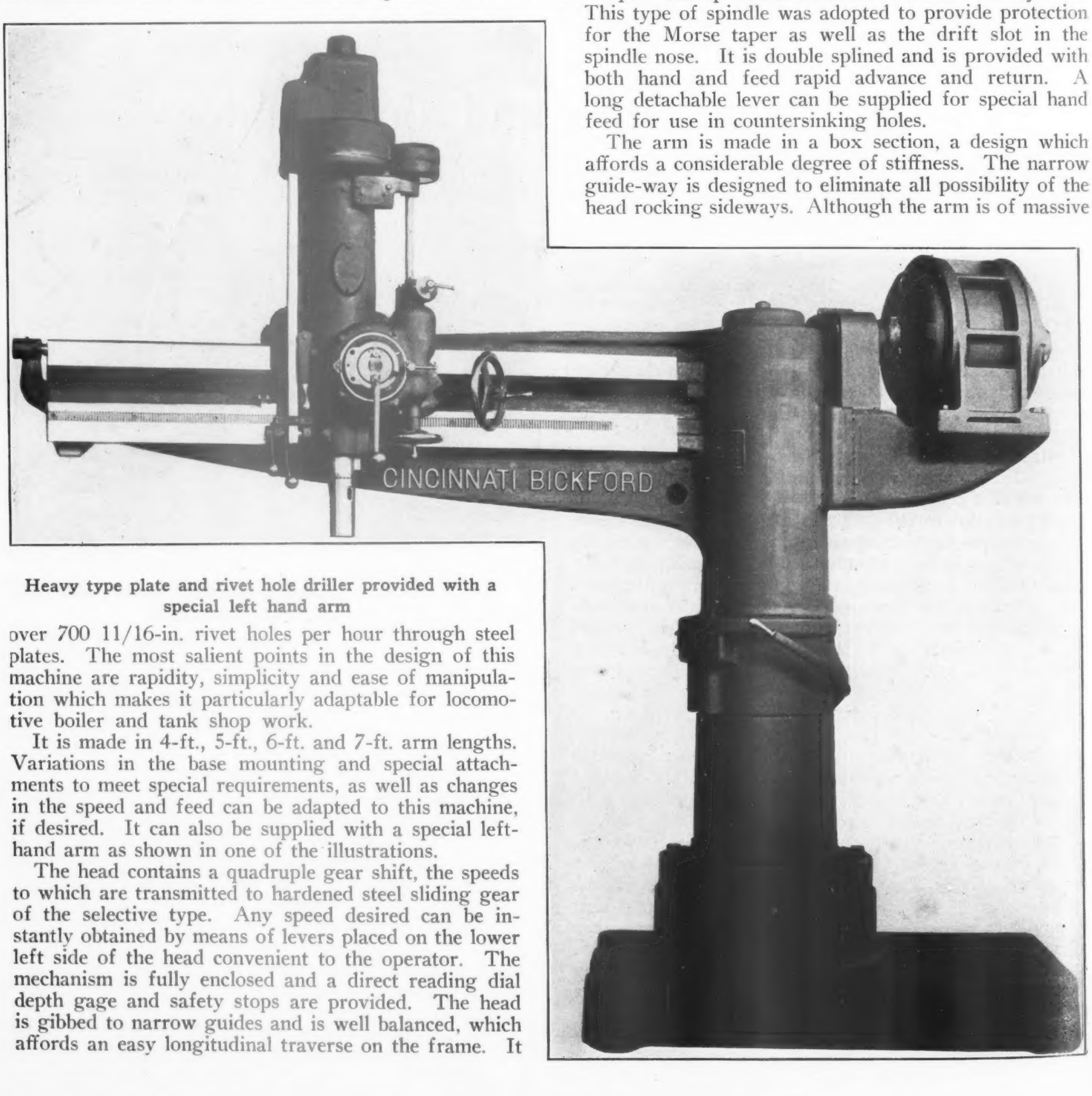
The table and sub-table are heavily ribbed castings, the sub-table being supported in the saddle bearing while the table is supported by the sub-table near the ends. It has one central T-slot.

The longitudinal movement of the table can be operated by either the large hand wheel located at the front of the saddle, or by a lever handle at the rear which imparts a quick travel to the table. Suitable means are provided in both the hand wheel and feed lever for disengaging them, thereby permitting independent operation by the front or rear of the table or by power feed. The cross feed is operated by the ball crank handle on the front of the saddle or by the ball crank handle at the side.

From the description just given, it will be noted that the workman can operate the cross feed, longitudinal feed and vertical movement, without having to change his position in front of the machine. This arrangement is especially convenient when grinding cylindrical work or surface grinding. The additional feature of rear control of all movements gives the operator an opportunity to observe the cutting action of the wheel on the work from the back of the machine.

Heavy type plate and rivet hole driller

A HEAVY plate and rivet hole drilling machine has recently been placed on the market by the Cincinnati-Bickford Tool Company, Cincinnati, Ohio. It is claimed that with this machine one operator can drill



Heavy type plate and rivet hole driller provided with a special left hand arm

over 700 11/16-in. rivet holes per hour through steel plates. The most salient points in the design of this machine are rapidity, simplicity and ease of manipulation which makes it particularly adaptable for locomotive boiler and tank shop work.

It is made in 4-ft., 5-ft., 6-ft. and 7-ft. arm lengths. Variations in the base mounting and special attachments to meet special requirements, as well as changes in the speed and feed can be adapted to this machine, if desired. It can also be supplied with a special left-hand arm as shown in one of the illustrations.

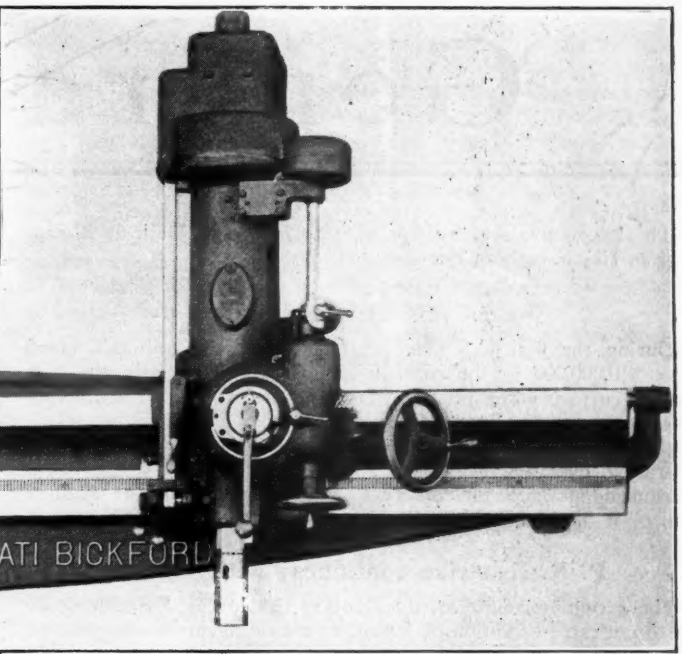
The head contains a quadruple gear shift, the speeds to which are transmitted to hardened steel sliding gear of the selective type. Any speed desired can be instantly obtained by means of levers placed on the lower left side of the head convenient to the operator. The mechanism is fully enclosed and a direct reading dial depth gage and safety stops are provided. The head is gibbed to narrow guides and is well balanced, which affords an easy longitudinal traverse on the frame. It can be clamped without disturbing the attachment for the gib.

The bearing for the spindle sleeve is lapped with cast iron laps. The spindle is made of heat treated alloy steel. This type of spindle was adopted to provide protection for the Morse taper as well as the drift slot in the spindle nose. It is double splined and is provided with both hand and feed rapid advance and return. A long detachable lever can be supplied for special hand feed for use in countersinking holes.

The arm is made in a box section, a design which affords a considerable degree of stiffness. The narrow guide-way is designed to eliminate all possibility of the head rocking sideways. Although the arm is of massive

construction, it can be easily swung in either direction by the operator. The motor is mounted on an extension of the arm behind the column.

The column clamp has a large clamping area for holding the arm and column. This construction prevents any movement of the arm when it is clamped which facilitates the spotting for holes and assists the operator in obtaining maximum production with the

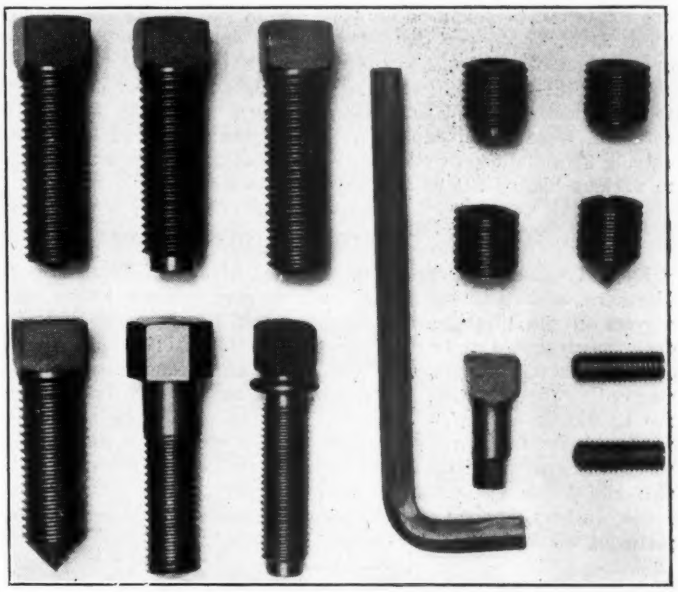



Motor driven drill press with base mountings and special attachments arranged to meet work requirements in the railroad shops

machine under the usual working conditions encountered in locomotive boiler shop work.

Set screws for use on eccentric rods

The illustration shows a number of square head, hexagon head and hollow set screws that have been designed to provide set screws of considerable torsional strength as well as ability to stand upsetting on the point. These set screws are said to have undergone a number of severe tests before being placed on the market. One of the tests to which the square and hexagon head set screws were subjected was to screw them down into a steel block that had been tapped about two-thirds of the way through. The set screw was then screwed into the block until either the set screw or block failed. In one of these tests the bottom of the hole was pushed out and the other tests resulted in fracturing the block. These screws were also given tension and compression tests. In the case of the hollow set screws, a block of steel was drilled and tapped through and the two screws were tightened against each other by placing one wrench in a vice and tightening the other screw down until either one of the screws or the block



Various styles of square and hexagon head and hollow set screws manufactured by Warren, Killion & Clark

failed. In this test also the block was fractured. These severe tests are made possible by the fact that the set screws are made from a special steel and treated according to a special process. This line of set screws is manufactured by the Warren, Killion & Clark Company, Inc., New York.

The New York Central about April 1, inaugurated the practice of running its passenger locomotives through between Chicago and Buffalo in both directions without change. This run, over a distance of 520 miles, is one of the longest, if not the longest, established with coal burning locomotives.

General News

The locomotive repair shops of the Chicago & Alton at Bloomington, Ill., have been closed for 60 days.

Cost of fuel in February

During the first two months of this year the railroads saved over $10,000,000 in the cost of fuel as compared with the cost for the corresponding period of last year, according to the monthly statement compiled by the Interstate Commerce Commission showing the amount and cost of fuel for road locomotives charged to operating expenses for Class I roads. In February the roads consumed 8,008,539 tons of coal, at an average cost of $2.81 a ton, or a total of $22,501,412, as compared with 9,040,988 tons.

P. R. R. strike continues "with vigor"

The executive counsel of the Railway Employees' Department of the American Federation of Labor, at a meeting in Washington on May 12 and 13, adopted resolutions soliciting "the largest possible support and co-operation of all those who are opposed to industrial tyranny," in behalf of the membership of the six shop crafts formerly employed on the Pennsylvania, whose strike, which began on July 1, 1922, is said to be "continuing with full vigor."

Cars and engines inspected in April

The Bureau of Locomotive Inspection of the Interstate Commerce Commission inspected 6,635 locomotives during April, according to the monthly report of the Interstate Commerce Commission to the President on the condition of railroad equipment. Of these 3,030, or 46 per cent, were found defective and 291 were ordered out of service. The Bureau of Safety during the month inspected 101,037 freight cars, of which 3,002, or 3 per cent, were found defective, and 2,475 passenger cars, of which 23, or 0.9 per cent, were found defective. During the month 12 cases, involving 21 violations of the safety appliance acts, were transmitted to various United States attorneys for prosecution.

A. T. & N. pays bonus to employees

John T. Cochrane, president of the Alabama, Tennessee & Northern, who promised a year ago to give bonuses to the employees in the three principal departments of the road, if each department should show for one year as favorable a percentage of expenses to earnings as in the year then closing, recently announced to the men that the bonus had been earned. This is for the 12 months ending with April, and was payable to men who continued in the service throughout the year. In the transportation department the beneficiaries were the enginemen, trainmen and hostlers; in the mechanical department, all mechanics, boiler washers, apprentices and pumpers; and in the roadway department, all foremen and assistant foremen.

Wage statistics for February

The number of employees reported by Class I railroads for February, 1925, was 1,725,366, a decrease of 2,967, or 0.2 per cent from the number reported for the previous month, according to the Interstate Commerce Commission's monthly bulletin of wage statistics. The total compensation decreased $19,488,816 or 8.0 per cent. This large decrease in compensation is due principally to the fact that there were only 23 working days in February, while January had 26. Compared with the returns for the same month last year, the employment shows a decrease of 1.6 per cent and the total compensation a decrease of 3.1 per cent. There was one more working day in February, 1924, than in February, 1925.

Gulf, Mobile & Northern awards fuel contest prize

The April fuel handicap was the most successful fuel contest ever held by the Gulf, Mobile & Northern. Engineer Frank Armour and Fireman W. J. Johnson on an eight-wheel passenger locomotive took first place in passenger service, using 1,340 lb. of coal per 100 passenger car-miles. Engineer J. E. Stephens and Fireman J. T. Metcalf on a Decapod locomotive took first place in through freight service, using 90 lb. of coal per thousand gross ton-miles. A new record of 122 lb. per thousand gross ton-miles was established for all freight service including locals, and 1,535 lb. per 100 passenger car-miles was established in passenger service for the month. Based on the business and the consumption for the previous month, the company saved over a car of coal a day.

New equipment

Class I railroads during the first three months this year placed in service 44,163 freight cars, according to reports filed with the Car Service Division of the American Railway Association, an increase of 6,511 cars over the corresponding period last year. Box cars numbered 22,665; coal cars, 15,995, and refrigerators 2,384.

Freight cars on order on April 1 this year totaled 46,126, a decrease of 23,172 from 1924. Of these, the box cars totaled 24,434; coal cars, 16,482, and refrigerators 1,933.

Locomotives placed in service during the first three months in 1925 numbered 430, a decrease of 231. Locomotives on order on April 1, 1925, totaled 315 compared with 520.

All of these figures include new, rebuilt and leased equipment.

Supplement published to the Rules of Interchange

A supplement to the current Rules of Interchange has been prepared by the Arbitration Committee of the American Railway Association containing interpretations of rules, 2, 4, 17, 18, 32, 36, 43, 87, 91, 98, 101, 104, 107 and 112, and passenger car rule 10. These supplements are now available for distribution and will be supplied on requisition. A sufficient quantity has been printed to supply one copy for each copy of the Interchange Rules printed. The prices to the members of the American Railway Association are as follows:

100 copies, or more, per hundred	$1.50
50 copies	1.00
Less than 50 copies, each	.03

To other than members of the American Railway Association, the supplements will be sold at six cents per copy. All remittances should be made payable to the American Railway Association, Chicago.

Court News

Charges against former railway shop crafts employees of contempt of court for violation of the injunction against violence in the shopmen's strike in 1922 were dismissed by Federal Judge Claude V. Luse at Superior, Wis., on May 8, according to press reports from that city. The injunction, which was alleged to have been violated, was granted the Chicago, St. Paul, Minneapolis & Omaha on July 20, 1922.

Safety appliance act held not to apply to car inspectors.—The Texas Court of Civil Appeals holds that, while the alinement of a drawhead preparatory to impact is a part of the act of coupling within the federal Safety Appliance Act, the act does not require drawbars to be kept in perfect alinement at all times. They must have some freedom of action to negotiate curves. The statutory duty is to keep them in such alinement and so equipped that they will couple automatically without the necessity of anyone going between the ends of the cars.

It is also held that a car inspector, whose duty it is to discover and repair defects in couplings, cannot recover under the federal act for injuries received in the course of his employment. This appears to be the first case in which the question of the application of the act to car inspectors has been passed upon.—K. C. M. & O. (Tex. Civ. App.), 262 S. W. 520.

Labor Board decisions

Demotion of carpenter foreman not covered by agreement.—A carpenter foreman on the New York, New Haven & Hartford, after three years' service as carpenter and 10 years as carpenter foreman, was demoted and his position assigned to another man, his junior in the service. The explanation offered was that his successor, while employed as a substitute during a vacation period, had demonstrated greater ability as a foreman in that his time books showed a better labor production. This position was contested by the United Brotherhood of Maintenance of Way Employees and Railway Shop Laborers, who contended that the action of the railroad was a discrimination and violation of seniority rights; and after unsatisfactory hearings with the railroads, carried the case before the Labor Board. The carrier's position was that the agreement with the brotherhood nowise covered foremen and contained no provision relating to the working conditions of the foremen. The decision of the board is that in the absence of any rule in the existing agreement governing the case the claim of the employees is denied.—*Decision No.* 3116.

Effect of type of engine on hostlers' compensation.—The Railroad Labor Board has decided that hostlers operating a small standard engine, which was rebuilt with the tank on top of the boiler and the coal space an integral part of the locomotive, used in switching and shifting engines at the roundhouses of the Missouri-Kansas-Texas at Parsons, Kans., shall be paid the engineers' rate for such service. The Labor Board denied the contention of the employees that two days' pay for each day of service is required in view of their contention that the engine is a shop-yard engine and that when hostlers are used to operate it during the course of their assignment as hostlers, they are entitled to not less than a minimum day as a hostler and in addition a minimum day as switch engineer under the engineers' contract. The management contended that the engines could not properly be regarded as yard engines. The management also contended that the shifting, handling and moving of engines in and about the roundhouse and roundhouse zone is work properly coming within the scope of employment of hostlers, that it is wholly immaterial what class of engine is used in the handling of such work.—*Decision No.* 3171.

Shop crafts co-operative plan to be tried on the North Western

A plan for the co-operation of its shops, similar to that first tried on the Baltimore & Ohio, has been approved in an agreement between the Chicago & North Western and the Federated Shop Crafts. The C. & N. W. is the fourth railway to try the experiment, the Canadian National and the Chespeake & Ohio having recently undertaken it.

Under the plan the management and the union agree to co-operate to improve service to the public, to share together any consequent benefit, and to perfect a definite administrative machinery to accomplish these purposes. The agreement reads in part:

"Aside from our mutual interest in the prosperity of the railway, one of the foremost benefits to the employees lies in the stability of employment, and the management is equally interested in the constant and efficient use of its shop facilities. Employees can without doubt bring to the attention of the management many points which will improve local conditions as to methods of planning and handling work in shops and roundhouses on Sundays and holidays and also promotion and co-operative attention to the welfare of the employees. These factors together with the economical use of time and forces, use of tools of the railway in the most advantageous manner, and performance of work by the minimum number of employees consistent with the various classes of work available will aid in the successful operation of the shops and repair facilities."

Conferences are to be held at local points where foremen and other local officers will meet with shop committeemen. It is expected that the first meeting will be held in the shops at Clinton, Iowa. The meetings are to be held on company time with the ranking officer of the railway or his representative acting as chairman of the joint committee. Subjects suggested for consideration are co-operation between departments; proper distribution, storage, and care of materials; increasing efficiency of tools and machines; disposition of scrap; most efficient method of handling engines through the shops; reclamation of usable material; condition of shops and shop grounds and arrangement of car repair tracks and tools. O. S. Beyer, Jr., consulting engineer of the Federated Shop Crafts, who assisted in the inauguration of the plan on the Baltimore & Ohio, will act in a consulting capacity to the union in the operation of the plan on the North Western.

Meetings and Conventions

Annual meeting of the A. S. T. M.

The annual meeting of the American Society for Testing Materials will be held June 23-26 at the Hotel Chalfonte-Haddon Hall, Atlantic City, N. J. Committee meetings will be held on Monday and Tuesday, the regular program opening on the evening of the latter day. The program includes double sessions on the last three days. The day's sessions and subjects are as follows: Tuesday, wrought iron, cast iron and corrosion; Wednesday, non-ferrous metals, metallography, ceramics, coal, timber, rubber, slate, presidential address and reports of administrative committees; Thursday, steel and fatigue of metals, road materials, waterproofing, roofing materials, research, testing, nomenclature and specifications; and Friday, paints, textiles, petroleum products, insulating material, cement, lime, gypsum and concrete.

A. S. M. E. nominations

The Nominating Committee of the American Society of Mechanical Engineers at its recent meeting at Milwaukee, Wis., nominated the following officers for the next calendar year: President, William L. Abbott, chief operating engineer, Commonwealth Edison Company, Chicago. Vice-Presidents, A. G. Christie, professor of mechanical engineering, Johns Hopkins Uni-

Freight car repair situation

1924	Number freight cars on line	Cars awaiting repairs: Heavy	Light	Total	Per cent of cars awaiting repairs	Month	Cars repaired: Heavy	Light	Total
January 1	2,279,363	118,653	39,522	158,175	6.9	December	87,758	2,073,280	2,161,038
April 1	2,274,750	125,932	46,815	172,747	7.6	March	77,365	2,213,158	2,290,523
July 1	2,279,826	144,912	49,957	194,869	8.5	June	70,480	1,888,899	1,959,379
October 1	2,304,020	157,455	48,589	206,044	8.9	September	74,295	1,372,277	1,446,572
January 1, 1925	2,293,487	143,962	47,017	190,979	8.3	December	66,615	1,288,635	1,355,250
February 1	2,305,520	139,056	47,483	186,539	8.1	January, 1925	69,084	1,358,308	1,427,392
March 1	2,313,092	141,192	43,855	185,047	8.0	February	66,283	1,313,088	1,379,371
April 1	2,315,732	143,329	43,088	186,417	8.1	March	71,072	1,348,078	1,419,150

Data from Car Service Division Reports.

Locomotive repair situation

Date, 1924	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No req. running repairs	Per cent	Total req. repairs	Per cent
February 1	64,377	53,586	4,116	5,919	9.2	4,872	7.6	10,791	16.8
April 1	64,363	52,805	4,648	6,128	9.5	5,430	8.4	11,558	17.9
July 1	64,416	53,382	7,117	6,035	9.4	4,999	7.7	11,034	17.1
October 1	64,538	53,209	5,424	6,175	9.6	5,154	8.0	11,329	17.6
January 1, 1925	64,384	53,118	4,849	5,927	9.2	5,339	8.3	11,266	17.5
February 1	64,308	52,994	4,220	6,143	9.6	5,171	8.0	11,314	17.6
March 1	64,255	52,851	4,988	6,217	9.7	5,187	8.0	11,404	17.7
April 1	64,230	52,619	6,241	6,345	9.9	5,266	8.2	11,611	18.1

Data from Car Service Division reports.

versity, Baltimore, Md.; William T. Magruder, professor of mechanical engineering, Ohio State University, Columbus, Ohio; Roy V. Wright, managing editor, Railway Age, and editor, *Railway Mechanical Engineer,* New York. Managers, Robert L. Daugherty, professor of mechanical ard hydraulic engineering, California Institute of Technology, Pasadena, Cal.; William Elmer, superintendent, Middle division, Pennsylvania Railroad Company, Altoona, Pa.; Charles E. Gorton, chairman, American Uniform Boiler Law Society, New York. Treasurer, Erik Oberg, editor, Machinery, New York.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Business meeting to be held in Chicago, June 16, 17 and 18. No exhibit of railway supplies and machinery will be held.
DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting September, 1925.
DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention August, 1925, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division. A. F. Steubing, Bradford Corp., 25 West Forty-third Street, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention week of September 14, 1925, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting, June 23-26, Chalfonte-Haddon Hall, Atlantic City, N. J.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 27 to 30, inclusive, Hotel Sherman, Chicago.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt Street, New York, N. Y. Regular meetings second Thursday each month, Hotel Statler, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Annual convention Hotel Sherman, Chicago, September 22-24.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month except July, August and September, at Hotel Cleveland, Public Square, Cleveland.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention, Hotel Winton, Cleveland, Ohio, August 18, 19 and 20.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Annual convention September 8-11, Hotel Sherman, Chicago.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday each month, except June, July and August at 29 West Thirty-ninth Street, New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in each month, except June, July and August.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth Street, Cleveland, Ohio. Annual meeting September 15-18, 1925, Chicago.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 189 West Madison Street, Chicago. Regular meetings third Monday in each month, except June, July and August.

Supply Trade Notes

The General Piston Ring Company, Indianapolis, Ind., has moved its plant and offices to Tipton, Ind.

The Chicago Pneumatic Tool Company will construct a one-story addition to its plant at Los Angeles, Cal.

The Symington Company has removed its New York office from the Woolworth building to 250 Park avenue.

The Sellers Manufacturing Company, Chicago, will construct a one-story rolling mill 85 ft. by 160 ft. to cost $30,000.

C. F. Moore has been appointed manager of railroad sales of Berry Brcs., Detroit, Mich., to succeed E. F. Fisher, resigned.

The Nathan Manufacturing Company has removed its executive offices from 21 East Fortieth street to 250 Park avenue, New York City.

The Standard Steel Car Company and subsidiary companies have removed their offices from 170 Broadway to 120 Broadway, New York City.

The Browning Crane Company is the new name adopted by the Browning Company, Cleveland, Ohio, makers of locomotive cranes and buckets.

C. B. Semple, 104 South Michigan avenue, Chicago, has been appointed Chicago representative of the C. H. Whall Company, Boston, Mass.

The office of William H. Keller, Inc., has been removed from 50 Church street to 54 Dey street, New York City. A. B. Inness is district manager.

The Pennsylvania Car Company plans the construction of a structual steel fabricating unit at its plant at Beaumont, Tex., to cost approximately $90,000.

The Atlas Steel Casting Company, Buffalo, N. Y., has removed its New York sales office from 200 Fifth avenue to 30 East Forty-second street, New York City.

The Harnischfeger Corporation, Milwaukee, Wis., has opened a branch office at 431 First National Bank building, Birmingham, Ala., in charge of James Van Buskirk, who has been transferred from the company's office at Detroit, Mich.

J. L. Price, vice-president and treasurer of the Chicago Pneumatic Tool Company, has been appointed vice-president and general manager of the newly organized Bendix Corporation, Chicago, and president and general manager of the Bendix Brake Company, South Bend, Ind., a subsidiary of the Bendix Corporation.

A. A. Boschert has been appointed sales engineer of the Harnischfeger Corporation, with headquarters at Seattle, Wash., to cover Washington and Oregon. The company has prepared plans for a one-story brick and steel addition, 60 ft. by 88 ft., to the core room of its electric steel foundry in Bay View, Wis.

The Coplan Steel Corporation, Inc., Ogdensburg, N. Y., has completed its plant at Ogdensburg, and is now on a production basis for the supply of chromatic heat resisting steel grate bars. A. H. Coplan is president and Godwin Shenton, vice-president, Ogdensburg. J. H. Burwell, 2708 Grand Central Terminal, is the New York representative.

Charles S. Durkee has been appointed western district sales manager in charge of the sale of stock products in the west and southwest, of J. H. Williams & Co., Buffalo, with headquarters at 117 N. Jefferson street, Chicago, Ill. Mr. Durkee has been with the Williams organization for 18 years and for the past two years was in charge of the central sales district, with headquarters at Buffalo.

Joseph M. Brown, formerly representing the W. F. Hebard Company, Chicago, has entered the sales organization of the Chicago Malleable Castings Company, Chicago, and will be engaged in the promotion of general sales. Guy Bishop, formerly sales representative of the Waugh Equipment Company, has been appointed sales representative of the Chicago Malleable Castings Company, Chicago.

Russell F. Kleinman, Land Title building, Philadelphia, Pa., has been appointed sales representative of the Scott Valve Manufacturing Company, Detroit, Mich. Mr. Kleinman will handle the company's line of valves in Eastern Pennsylvania, Southern New Jersey, Maryland, Delaware and the District of Columbia. The Charles H. Tinker Company, 201 Devonshire street, Boston, Mass., has been appointed New England representative.

An engineering research department to study the requirements for automatic control and other problems in various industries, and an experimental department have been created by the C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y. Victor Wichum, chief engineer, is in charge of the engineering research department, and Frank Bast continues in charge of development work on indicating, recording and controlling instruments. R. M. Wilhelm, formerly of the Bureau of Standards, is in charge of the development of oil-testing instruments. Daniel C. Day is working on some of the more important problems of the users of TAG instruments, under Harvey D. Cooke, general sales manager. William C. Begeebing is in charge of automatic controllers, dial indicating and recording thermometers.

Joseph J. McGarrigle has been appointed eastern manager of the Clark Car Company, succeeding B. K. Mould, resigned. His headquarters are at 52 Vanderbilt avenue, New York City. Mr. McGarrigle graduated in civil and structural engineering from the Pennsylvania State College in the class of 1914. He served in the engineering department of the American Bridge Company until 1916, and then entered the engineering department of the Department of City Transit, Philadelphia, Pa. Mr. McGarrigle served as first lieutenant in the United States Army from July, 1917, until he went to the Midvale Steel & Ordnance Company, car department, general sales, Philadelphia, Pa., in 1919, and when it was merged with the Bethlehem Steel Company he remained in the same department until the time of his joining the Clark Car Company on November 1, 1924.

C. P. Wright, assistant vice-president of the American Brake Shoe & Foundry Company at Chicago, has been promoted to vice-president, with the same headquarters. Mr. Wright was born in Garrett, Ind., on September 12, 1880, and after graduating from high school entered railway service with the Baltimore & Ohio. A year later he entered the employ of the Ansonia Clock Company in Chicago and later the employ of the Chicago Grain Door Company, with the same headquarters. On August 1, 1900, he entered the employ of the Featherstone Foundry & Machine Company, which was absorbed by the American Brake Shoe & Foundry Company. During the past 7 years of his employ with the American Brake Shoe & Foundry Company he has been assistant to the vice-president and assistant vice-president at Chicago.

C. P. Wright

George M. Hogan, secretary and general sales agent of the Sellers Manufacturing Company, with headquarters in Chicago, has been promoted to vice-president, with the same headquarters. He was born in Chicago on October 9, 1883, and received his education in St. Ignatius College, Chicago. He entered the employ of the Sellers Manufacturing Company on August 20, 1906, as a shipping clerk in the plant in Maywood, Ill. He held several positions in the operating and accounting departments in the plant until October 1, 1912, when he entered the sales department as sales agent, with headquarters in Chicago. He held the latter position until April, 1917, when he was promoted to general sales agent, which position he held until January 1, 1918, when he was appointed assistant secretary and general sales agent, with the same headquarters. In February, 1919, he was promoted to secretary and general sales agent.

Trade Publications

PUNCH RIVETERS.—Bulletin R-203, illustrating and describing Hanna rapid punch riveters, has been issued by the Hanna Engineering Works, Chicago.

JACKS.—A safety suggestion concerning all types of double-acting tripping track jacks has been issued in bulletin form by Templeton, Kenly & Co., Ltd., Chicago, Ill.

GRINDING MACHINES.—A few typical jobs as handled by the Heald railroad internal grinder are shown in the pages of a 20-page pamphlet, Bulletin No. 522, issued by the Heald Machine Company, Worcester, Mass.

RIVETERS.—Hanna bull riveters, which are built in sizes ranging from 4 in. to 21 ft. reach, and in capacities from 6 to 150 tons, are described and illustrated in a 36-page bulletin, R-204, recently issued by the Hanna Engineering Works, Chicago.

FLEXIBLE COUPLINGS.—Bulletin No. 35 descriptive of Falk-Bibby flexible couplings has been issued by the Falk Corporation, Milwaukee, Wis. The couplings, designed for every purpose, range in speed from 1/3 to 20,000 h. p. at 100 r. p. m.

ASCO BULLETINS.—"Do your men really know what end ladder clearance is and how to measure it?" is the title of Bulletin No. 4, and "How much money are you losing through non-observance of A. R. A. Rule 86, paragraph 'd'?" are the titles of Bulletins No. 4 and 5 which have recently been issued by the Allegheny Steel Company, Brackenridge, Pa.

BRIDGEPORT PRODUCTS.—Tabulated data, giving the weights, sizes and lengths of Bridgeport products, including brass and copper sheet, rod, wire and shapes, tubing, piping and fabricated articles, are contained in a 48-page booklet, No. 16, which has been issued by the Bridgeport Brass Company, Bridgeport, Conn. Price lists, conversion tables, etc., are also included in the booklet.

TURRET LATHES.—Practical methods for producing turned parts in lots of five to fifteen pieces by the use of machines with standard adjustable tools, are outlined in a 12-page circular, entitled "Profits from small lot production," which has been issued by the Warner & Swasey Company, Cleveland, Ohio. Illustrations show the main points in set-up, and set-up times from actual jobs are given.

FORGED STEEL PIPE FLANGES.—An attractive catalogue of 86 pages, the purpose of which is to place before those who use or specify flanges a complete list of standard forged steel flanges, together with data, descriptions and other information helpful in connection with high pressure piping layouts or pipe fabrications, has been issued by the American Spiral Pipe Works, Chicago. Formulas and data tables embody the new American Engineering standards of 400, 600 and 900 lb. W. S. P., and cover also the existing standards. Full-size cross-sectional drawings show modern practice in the field of increasing pressures and superheat. A section of the catalogue is also devoted to corrugated steel furnaces.

PYROMETERS.—A 56-page catalogue descriptive of indicating, portable and recording pyrometers has been issued by the Republic Flow Meters Company, Chicago. The equipment and methods used in the manufacturing plant of the company are attractively presented in the first few pages of the catalogue. The seven following pages are descriptive of pyrometer applications in the larger industries and contain a full size view showing the upper recording mechanism of the instrument and charts, also a photograph showing the complete accessibility of mechanism. How to select thermo couplers is the subject of the next section of the catalogue, wherein base and rare metal elements and their protection are described and various thermo-couplers and protecting tubes illustrated. The importance of correct interpretation of pyrometer readings, pyrometer maintenance, cold junction errors and how they are eliminated, suppressed zero instruments are the features next taken up. The remaining pages contain specifications and recommended heat treatments for S. A. E. steel, Fahrenheit-Millivolt equivalent charts, a conversion table of Fahrenheit and Centigrade scales and a table of melting points of chemical elements.

Personal Mention

General

C. P. PEROT, motive power inspector of the Pennsylvania at Altoona, Pa., has been appointed motive power inspector, office of superintendent of motive power, Southern division.

W. R. CUTTREL, motive power inspector of the Pennsylvania at Altoona, Pa., has been appointed motive power inspector, office of superintendent of motive power, New Jersey division.

R. G. Bennett, superintendent of motive power of the Eastern Ohio division, Central region of the Pennsylvania, has been promoted to general superintendent of motive power of the Southwestern region of the Pennsylvania, with headquarters at St. Louis, Mo., succeeding F. G. Grimshaw. Mr. Bennett was born on March 31, 1882, at Brighton, England, and was graduated from Purdue University in 1908. He entered railway service in January, 1900, as a machinist apprentice on the Pennsylvania, and completed his apprenticeship in 1904. While attending college, Mr. Bennett was employed during summer months as a machinist, draftsman and inspector on the Pennsylvania. In November, 1908, he was appointed motive power inspector. In March, 1912, he was transferred to the maintenance of way department as a rodman; in March, 1913, appointed inspector in the tests department in charge of the locomotive test plant at Altoona, Pa.; in May, 1916, promoted to assistant master mechanic; in February, 1917, promoted to assistant engineer of motive power of the Central division; in July, 1917, appointed master mechanic at Sunbury, Pa., and in May of the following year, transferred to the Pittsburgh division. He was promoted to superintendent of motive power of the Central Pennsylvania division in December, 1919.


R. G. Bennett

O. P. Reese, assistant general superintendent of motive power of the Northwestern region of the Pennsylvania, at Chicago, has been appointed superintendent of motive power of the Eastern Ohio division, Central region, succeeding R. G. Bennett. Mr. Reese was born on May 20, 1876, at Louisville, Ky., and was graduated from Purdue University in 1898. He entered railway service in August, 1898, as an apprentice the Louisville & Nashville, which position he held until September, 1900, when he became a draftsman for the Pennsylvania at Allegheny, Pa. From September, 1900, to September, 1901, he was engaged on special work for that road at Fort Wayne, Ind., and from the latter date to August, 1903, he was a special apprentice. In August, 1903, he became gang foreman at Allegheny, Pa., and held this position until February, 1904. From this time on he held the following positions consecutively: February, 1904, to December, 1904, foreman of tests for the Pennsylvania at the St. Louis World's Fair; December, 1904, to May, 1905, motive power inspector; May, 1905, to May, 1906, general division foreman; June, 1908, to June, 1910, division master mechanic; June, 1910, to September, 1911, assistant engineer of motive power; September, 1911, to May, 1915, master mechanic; May, 1915, to January, 1917, assistant engineer of motive power in the office of the general superintendent of motive power of the same road; January, 1917, to March, 1920, superintendent of motive power of the Central system of the Lines West of Pittsburgh, at Toledo, Ohio; March, 1920, to April, 1921, the same position on the Northern Ohio division. From April, 1921, to February, 1924, Mr. Reese was superintendent of motive power of the Illinois division, and from February, 1924, until his recent promotion, assistant general superintendent of motive power.


O. P. Reese

Master Mechanics and Road Foremen

J. H. WESTON, road foreman of engines of the Minnesota division of the Northern Pacific, at Staples, Minn., has been appointed road foreman of engines of the Fargo division, with the same headquarters.

C. W. ADAMS, whose appointment as master mechanic of the Michigan Central at Jackson, Mich., was announced in the May issue of the *Railway Mechanical Engineer*, was born on March 17, 1885, at St. Thomas, Ont. Mr. Adams received a public and high school education and in September, 1902, entered the employ of the Michigan Central. From 1906 until October, 1920, he served successively as machinist, erecting foreman, roundhouse foreman and general foreman at St. Thomas. He then became superintendent of shops and remained in this position until his appointment as master mechanic as noted above.

Car Department

H. MARSH has been appointed car foreman of the Ashland division of the Chicago & Northwestern, with headquarters at Antigo, Wis.

H. BARRER has been appointed general car foreman of the Galena division of the Chicago & Northwestern, with headquarters at (Wood Street) Chicago.

G. R. ANDERSON has been appointed district master car builder of the Chicago terminal, Wisconsin, Galena and Southern Illinois divisions of the Chicago & Northwestern, with headquarters at Chicago, succeeding C. J. Nelson, resigned.

J. C. BYRNE has been appointed assistant district master car builder of the Chicago terminal, Wisconsin, Galena and Southern Illinois divisions of the Chicago & Northwestern, with headquarters at Chicago, succeeding G. R. Anderson.

Shop and Enginehouse

A. A. MADER has been appointed boiler foreman of the Atchison, Topeka & Santa Fe, with headquarters at Brownwood, Tex.

R. O. ROGERS has been appointed night roundhouse foreman of the Atchison, Topeka & Santa Fe, with headquarters at Waynoka, Okla.

M. L. CARLSON has been appointed day roundhouse foreman of the Atchison, Topeka & Santa Fe, with headquarters at Waynoka, Okla.

J. VOGEL, boiler foreman of the Atchison, Topeka & Santa Fe at Albuquerque, N. M., has been appointed night boiler foreman, with headquarters at Wellington, Kan.

Purchasing and Stores

G. F. BATTENFIELD has been appointed general storekeeper of the St. Louis Southwestern at Tyler, Texas, succeeding F. C. Warren.

F. C. WARREN, general storekeeper of the St. Louis Southwestern, with headquarters at Tyler, Texas, has been transferred to Pine Bluff, Ark.

J. W. TAYLOR, formerly vice-president in charge of purchasing and stores of the Chicago, Milwaukee & St. Paul and, since the receivership, chief purchasing officer, has retired from active service.